ENVIRONMENTAL MANAGEMENT

ROBINS AFB

DRAFT FINAL
ANNUAL PROGRESS REPORT
DECEMBER 2009 - NOVEMBER 2010
FOR
SWMU 4/LF04 OU3 RECORD OF DECISION;
SWMU 20/OT20 CORRECTIVE ACTION PLAN;
SWMUs 3, 6 & 13/LF03 CORRECTIVE ACTION PLAN;
SWMUs 17 & 24/OT17 CORRECTIVE ACTION PLAN;
SWMU 62/OT37 CORRECTIVE ACTION PLAN;
SWMU 57/OT41 & SWMU 61 CORRECTIVE ACTION PLAN;
AND
GROUNDWATER TREATMENT SYSTEM

78 CEG/CEAN
Robins Air Force Base, Georgia

March 2011

DRAFT FINAL

ANNUAL PROGRESS REPORT DECEMBER 2009 - NOVEMBER 2010 FOR SWMU 4/LF04 OU3 RECORD OF DECISION; SWMU 20/OT20 CORRECTIVE ACTION PLAN; SWMUs 3, 6 & 13/LF03 CORRECTIVE ACTION PLAN; SWMUs 17 & 24/OT17 CORRECTIVE ACTION PLAN; SWMU 62/OT37 CORRECTIVE ACTION PLAN; SWMU 57/OT41 & SWMU 61 CORRECTIVE ACTION PLAN; AND GROUNDWATER TREATMENT SYSTEM

FOR

ENVIRONMENTAL MANAGEMENT BRANCH
78TH CIVIL ENGINEER GROUP
(78 CEG/CEAN)
ROBINS AIR FORCE BASE, GEORGIA

CONTRACT NO. W912HN-09-D-0048,
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Prepared by:
Geosyntec Consultants

March 2011

Jimmy Whitmer, P.G.
Program Manager

Cuneyt Gokmen, P.E.
Delivery Order Manager

Tamara Hebeler, P.E.
Task Manager

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CERTIFICATION

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SWMU 57/OT41 & SWMU 61 CORRECTIVE ACTION PLAN;
AND
GROUNDWATER TREATMENT SYSTEM

PREPARED FOR:

78 CEG/CEAN
ROBINS AIR FORCE BASE, GEORGIA

I certify that I am a qualified engineer who has received a baccalaureate or post-graduate degree in engineering, and have sufficient training and experience in engineering, as demonstrated by state registration and completion of accredited university courses, that enable me to make sound professional judgments regarding engineering design and construction. I further certify that this document was prepared by me or by a subordinate working under my direction.

GEORGIA REGISTERED No. PE030463 PROFESSIONAL ENGINEER TAMARA E. HEBELER

Tamara Hebeler, P.E.
Task Manager
Georgia Reg. No. 030463

LABORATORY CERTIFICATION

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SWMU 57/OT41 & SWMU 61 CORRECTIVE ACTION PLAN;
AND
GROUNDWATER TREATMENT SYSTEM

PREPARED FOR

78 CEG/CEAN
ROBINS AIR FORCE BASE, GEORGIA

LABORATORY NAME: Gulf Coast Analytical Laboratories, Inc., 7979 GSRI Avenue, Baton Rouge, Louisiana 70820
ACCREDITING AGENCY: State of Louisiana (LA)
ACCREDITATION IDENTIFIER NUMBER: LA – No. 01955
SCOPE OF WORK: LA – Clean Water, Air, Solid/Hazardous Waste, CLP Methods, and Miscellaneous
EFFECTIVE ACCREDITATION/EXPIRATION DATES:
LA – 1 July 2009 through 30 June 2010
LA – 1 July 2010 through 30 June 2011

I certify that this laboratory is accredited to perform the scope of work in accordance with the Rules for Commercial Environmental Laboratories, Chapter 391-3-26, Georgia Department of Natural Resources, which requires all commercial analytical laboratories submitting data for regulatory purposes be accredited or approved as specified in those Rules. A copy of the laboratory's certificate is provided in Appendix A.

Tamara Hebeler, P.E.
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AND
GROUNDWATER TREATMENT SYSTEM

PREPARED FOR

78 CEG/CEAN
ROBINS AIR FORCE BASE, GEORGIA

LABORATORY NAME: Gulf Coast Analytical Laboratories, Inc., 7979 GSRI Avenue, Baton Rouge, Louisiana 70820
ACCREDITING AGENCIES: Naval Environmental Restoration (ER) Quality Assurance Program (QAP); Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP)
CERTIFICATION NUMBERS: Naval ER QAP – Not Available; DoD ELAP – ADE-1482
SCOPE OF WORK: See Appendix A
EFFECTIVE ACCREDITATION/EXPIRATION DATES:
Naval ER QAP – Unknown through 11 September 2010
DoD ELAP – 9 September 2010 through 9 September 2012

I certify that this laboratory is accredited to perform the scope of work in accordance with DOD ELAP. Effective 1 October 2009, all commercial analytical laboratories testing in support of DoD environmental restoration programs are required to be accredited by DoD ELAP. Copies of the laboratory's approvals are provided in Appendix A.

Tamara Hebeler, P.E.
Task Manager
Georgia Reg. No. 030463

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AND
GROUNDWATER TREATMENT SYSTEM

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ROBINS AIR FORCE BASE, GEORGIA

LABORATORY NAME: Test America Knoxville, 5815 Middlebrook Pike, Knoxville, Tennessee 37921
ACCREDITING AGENCY: State of Florida (FL)
ACCREDITATION IDENTIFIER NUMBER: FL – No. E87177
SCOPE OF WORK: FL – Examination of Environmental Samples in the following Categories: Drinking Water, Non-Potable Water, Solid and Chemical Materials, Biological Tissue, and Air and Emissions
EFFECTIVE ACCREDITATION/EXPIRATION DATES:
FL – 1 July 2009 through 30 June 2010
FL – 1 July 2010 through 30 July 2011

I certify that this laboratory is accredited to perform the scope of work in accordance with the Rules for Commercial Environmental Laboratories, Chapter 391-3-26, Georgia Department of Natural Resources, which requires all commercial analytical laboratories submitting data for regulatory purposes be accredited or approved as specified in those Rules. A copy of the laboratory's certificate is provided in Appendix A.

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AND
GROUNDWATER TREATMENT SYSTEM

PREPARED FOR

78 CEG/CEAN
ROBINS AIR FORCE BASE, GEORGIA

LABORATORY NAME: Test America Knoxville, 5815 Middlebrook Pike, Knoxville, Tennessee 37921

ACCREDITING AGENCIES: Naval Environmental Restoration (ER) Quality Assurance Program (QAP); Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP)

CERTIFICATION NUMBERS: Naval ER QAP – Not Available; DoD ELAP – ADE-1434

SCOPE OF WORK: See Appendix A

EFFECTIVE ACCREDITATION/EXPIRATION DATES:

Naval ER QAP – Unknown through 30 December 2009; DoD ELAP – 24 February 2010 through 24 February 2012 (No samples were analyzed between 31 December 2009 and 23 February 2010)

I certify that this laboratory is accredited to perform the scope of work in accordance with DOD ELAP. Effective 1 October 2009, all commercial analytical laboratories testing in support of DoD environmental restoration programs are required to be accredited by DoD ELAP. Copies of the laboratory's approvals are provided in Appendix A.

Tamara E. Hebeler

Tamara Hebeler, P.E.
Task Manager
Georgia Reg. No. 030463

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EXECUTIVE SUMMARY

The Groundwater Treatment System (GWTS) at Robins Air Force Base (Robins AFB or the Base), Georgia consists of a number of individual and interconnected components and processes associated with various restoration sites located on the Base. Restoration sites are areas that have been identified through site investigation and other means as having been environmentally impacted by historical operations.

Contaminated groundwater (also including landfill leachate from one of the restoration sites) is recovered and/or extracted at six restoration sites and pumped to the centralized Groundwater Treatment Plant (GWTP) through a network of underground, double-walled piping (i.e., force main). The GWTP consists of several treatment processes and is designed to operate on a continuous basis. Treated effluent from the GWTP is monitored and discharged to the nearby Ocmulgee River in accordance with the conditions of the Base's wastewater discharge permit [National Pollutant Discharge Elimination System (NPDES) Permit number GA0002852].

The purpose of the GWTS is to facilitate remediation of the associated restoration sites. Remediation efforts at these sites are being conducted in accordance with various Federal and State regulatory requirements, chiefly the Resource Conservation and Recovery Act (RCRA) for the Solid Waste Management Units (SWMUs) and, for one restoration site [Landfill Number (No.) 4 (LF04)], the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Remedial action for each site is conducted in accordance with the respective Corrective Action Plan (CAP) approved by the Georgia Department of Natural Resources, Environmental Protection Division (GA EPD) or the Record of Decision (ROD) approved by the United States Environmental Protection Agency (US EPA). As required by the CAPs and ROD, and in accordance with the GWTS Operations and Maintenance (O&M) Plan, sampling, monitoring, and reporting activities are conducted on an ongoing basis. The Annual Progress Report presented herein summarizes the GWTS operations and remediation progress at the associated sites during the reporting period December 2009 through November 2010.

Conclusions and recommendations for each site, the GWTP, and the GWTS in its entirety are presented below. Complete information, evaluations, and data upon which these statements are based are contained in this report and its tables, figures, and appendices.

SWMU 4/LF04

The primary remedial action objectives (RAOs) for LF04, as stated in the 2004 Final ROD, are: (i) achieve containment and exposure control; (ii) prevent potential impact to adjacent wetlands; and (iii) restore groundwater to Maximum Contaminant Levels (MCLs)/Remedial Levels (RLs). The discussion which follows briefly describes the site's remedial system and its performance relative to these objectives during the reporting period.

The LF04 remedial system consists of groundwater recovery wells, a cover system with passive landfill gas vents, and implementation of land use controls. The groundwater recovery system at LF04 was shut down, with regulatory approval, on 1 February 2007, and a study was initiated to evaluate transitioning the site remedy to a monitored natural attenuation (MNA) approach. Based on the results of this study, the site remedy was transitioned to MNA, with regulatory approval, in 2010. For this reporting period, the following conclusions and recommendations are made with respect to the remedial system at LF04.

Primary contaminants [i.e., trichloroethene (TCE) and cis-1,2-dichloroethene (cis-DCE)] are no longer detected in the surficial aquifer. A limited number of other residual contaminants are still present at generally low concentrations in the surficial aquifer within the landfill. Groundwater data from the site generally indicate that the underlying alluvial aquifer and areas outside the landfill are not impacted by these residual contaminants.

TCE concentrations in the alluvial aquifer have decreased significantly since 1997, when the maximum TCE concentration was 2,800 micrograms per liter (µg/L), to a maximum concentration of 36 µg/L in 2010. The lateral extent of the contaminant plume has been reduced to approximately one-quarter of its 1997 size.

Groundwater data collected since the shutdown of the groundwater recovery system indicate that the plume is not migrating and that decreasing concentration trends are continuing at the majority of the wells. Slight rebound observed shortly after the shutdown of the groundwater recovery system was limited and well within the anticipated increase in concentrations, and concentrations at each of these locations have since decreased.

The groundwater data in the alluvial aquifer continue to indicate that the time frame to achieve the remedial objectives with an MNA approach is reasonable when compared to operation of the groundwater recovery system and is anticipated to be on the order of approximately ten years. Operation of the groundwater recovery system will not provide any additional benefit over an MNA approach. Therefore, no modifications are anticipated for LF04 during the upcoming year.

SWMU 20/OT20

The corrective action objectives for Other Site 20 (OT20) are: (i) to achieve mass removal from areas of the groundwater plume containing the most elevated contaminant concentrations; and (ii) MNA for the portions of the plume not impacted by the remedial system. The discussion which follows briefly describes the site's corrective action system and its performance relative to these objectives during the reporting period.

The OT20 corrective action system consists of groundwater extraction wells and an air sparge/soil vapor extraction (AS/SVE) system. For this reporting period, the following conclusions and recommendations are made with respect to the operation of the corrective action system at OT20.

Progress toward reaching the CAP objectives at this site is significant. The combination of groundwater extraction along with AS/SVE mass removal is producing a noticeable decline in contaminant concentrations in the upper and lower Providence aquifers. The plume has bifurcated along the alignment of the AS/SVE system, and TCE concentrations in the monitoring wells downgradient have shown significant decreases since this system began operation. The groundwater extraction and AS/SVE systems, as well as natural attenuation, are effective at reducing contaminant concentrations and controlling plume migration.

It is estimated that 208 pounds (lbs) of total organics were removed by the OT20 groundwater extraction system during the current reporting period. Since its startup in October 1997, the OT20 groundwater extraction system has removed approximately 11,302 lbs of total organics. Additionally, the AS/SVE system at OT20 removed approximately 59 lbs of TCE and 491 lbs of total Volatile Organic Compounds (VOCs) during this reporting period, and 827 lbs of TCE and 41,473 lbs of total VOCs since beginning operation in July 2003.

No major structural or process modifications are anticipated during the upcoming year.

SWMU 3/LF03

The corrective action objectives for Landfill No. 3 (LF03) are: (i) source control; (ii) hydraulic containment of the dissolved-phase plume; and (iii) remediation of groundwater and surface water to MCLs/RLs. The discussion which follows briefly describes the site's corrective action system and its performance relative to these objectives during the reporting period.

The LF03 corrective action system consists of groundwater extraction wells, an interceptor trench, a leachate collection system, an active landfill gas collection system, a slurry wall around the landfill, a cover system, and an SVE system. For this reporting period, the following conclusions and recommendations are made with respect to the operation of the corrective action system at LF03.

The hydraulic gradient between the inside and outside of the landfill indicates that an inward gradient is generally maintained except at the north end of the landfill. The GA EPD has waived the 2-foot inward gradient requirement of the CAP near the north end of the landfill for as long as pumping from the interceptor trench and/or LF3EW3 through LF3EW6 and LF3EW9 is continued. The interceptor trench and LF3EW8 were shut down, with regulatory approval, on 23 April 2009.

Groundwater elevation data indicate that the extraction system provides hydraulic containment of the dissolved phase plume north of Luna Lake. Contaminants of Concern (COCs) were not detected above their respective RLs in surface water samples collected from LF03SSW03 in 2010. LF03SSW02 and LF03SSW04 were dry at the time of the scheduled sampling events, and field investigation efforts did not identify additional seep locations. The dry seeps, as well as the low concentrations at LF03SSW03, provide further evidence of the effectiveness of the hydraulic containment system.

It is estimated that the LF03 groundwater extraction system removed 2,180 lbs of total organics from the subsurface during this reporting period, bringing the total to 15,228 lbs of total organics removed since its operation began in May 2000. In addition to the mass removed by the groundwater and leachate extraction system, the landfill gas collection system and the SVE system contributed to the overall contaminant mass removal by removing over 1,544 lbs of VOCs and 17,712 lbs of methane, during this reporting period. Cleanout efforts at the LF03 transfer station pump have also resulted in additional mass removal from LF03.

Concentrations at LF3EW3 have been below the MCL for three consecutive sampling events. Given the low contaminant concentrations at this well and the potential for continued pumping to cause the plume to migrate toward this location, continued operation of this well will be of little further benefit. It is recommended that pumping from LF3EW3 be discontinued.

SWMU 17/OT17

The corrective action objectives for OT17 are to: (i) initiate mass removal; (ii) arrest lateral and vertical dissolved phase plume expansion; and (iii) reduce COCs to below the MCLs. The discussion which follows briefly describes the site's corrective action system and its performance relative to these objectives during the reporting period.

The OT17 corrective action system consists of groundwater extraction wells (including a horizontal well) and an SVE system. For this reporting period, the following conclusions and recommendations are made with respect to the operation of the corrective action system at OT17.

It is evident that the groundwater extraction and SVE systems have been effective at reducing source area concentrations in the immediate vicinity of Building 645. The plume in both the shallow and deep aquifers is stable and not migrating, as indicated by stable and/or declining contaminant concentrations on the leading edge of the plume. However, concentrations continue to remain above MCLs at many locations. To address this observation, Robins AFB proactively initiated supplementary field investigations, which have resulted in a better understanding of the plume configuration both in the shallow and deep aquifers and the interconnectivity of these aquifers. Data from the supplementary investigations indicate that the core of the plume in the shallow and deep aquifers has higher TCE concentrations and covers a larger area than previously estimated.

During this reporting period, Robins AFB continued efforts to optimize the remedial system currently in place at the site in light of the data obtained from the supplementary field investigations. These efforts included aquifer testing to further evaluate the hydraulic connection between the shallow and deep aquifers and contaminant transport through the clay unit separating these two aquifers. The aquifer test data were used to refine the groundwater model for this site and to optimize the groundwater extraction system. As a result, three additional vertical groundwater extraction wells have been installed at the site to increase contaminant mass removal. The wells are expected to commence operation in December 2010.

The OT17 groundwater extraction system removed approximately 366 lbs of total organics during this reporting period and approximately 3,846 lbs of total organics since beginning operation in May 2000. In addition, the SVE system removed an estimated 117 lbs of TCE, bringing the cumulative total of TCE removed by the SVE system to date to approximately 3,814 lbs. The groundwater extraction and SVE systems remained effective at removing contaminant mass from the site.

No major structural or process modifications are anticipated during the upcoming year.

SWMU 62/OT37

The corrective action objective for OT37 is to reduce TCE concentrations in groundwater to MCLs. The discussion that follows briefly describes the site's corrective action system and its performance relative to these objectives during the reporting period.

The OT37 corrective action system consists of two groundwater extraction wells. OT37EW1 was shut down, with regulatory approval, on 23 April 2009. For this reporting period, the following conclusions and recommendations are made with respect to the operation of the corrective action system at OT37.

The historical plume configurations show that significant remedial progress is being made at OT37. The overall configuration of the groundwater contaminant plume reduced in size, including the core of the plume, and TCE concentrations along the leading edge of the plume continued to decline. Decreasing contaminant concentrations were observed across the site, and the maximum TCE concentration has decreased from 920 µg/L in 2001 to 270 µg/L in 2010. These significant achievements are due to extensive system optimization efforts at OT37EW2 and natural attenuation of the plume.

The OT37 extraction system has removed 63 lbs of total organics since the system began operation in August 2002. The eight lbs removed during this reporting period represents a slight decrease from the previous reporting period and is reflective of the decrease in TCE concentrations across the site, and more specifically at OT37EW2, and the slight decrease in flow at the site due to the shutdown of OT37EW1 during the previous reporting period.

No major structural or process modifications are anticipated during the upcoming year.

SWMU 57/OT41 and SWMU 61

The corrective action objectives for OT41 and SWMU 61 are to: (i) reduce potential sources of groundwater contamination (i.e., residual and free phase contaminants); (ii) reduce COC concentrations in groundwater to values less than the site-specific RLs; and (iii) minimize the migration of groundwater contaminants from the commingled OT41 and SWMU 61 plumes into the adjacent wetland. The discussion which follows briefly describes the site's remedial systems and their performance relative to these objectives during the reporting period.

The OT41 and SWMU 61 corrective action system consists of groundwater extraction wells at OT41 and an AS/SVE system at SWMU 61. The AS/SVE system at SWMU 61 was shut down, with regulatory approval, on 26 January 2009 to assess rebound potential and potentially transition the site to an MNA remedy for any residual contamination that may be present. The groundwater extraction system at OT41 continues to remain in operation. For this reporting period, the following conclusions and recommendations are made with respect to the operation of the corrective action system at OT41 and SWMU 61.

The primary COCs at the site continue to be benzene (associated with historic fuel-related releases from SWMU 61) and chlorobenzene (associated with historic releases from OT41). There has been a significant reduction in the contaminant concentrations and plume size in the source area at SWMU 61 since the groundwater extraction and AS/SVE systems began operation. SWMU 61 COC concentrations at S61W1, S61W2, and S61W3 have been below their respective concentrations since 2007. Benzene concentrations in the remaining well (S61W4) have rapidly decreased from a high of 7,980 μg/L in 2001 to 6.4 μg/L in 2008, and have remained steady at this same concentration through the 2010 basewide sampling event. The results of the rebound study indicate that the COC concentrations at this site have remained low with no evidence of rebound following the shutdown of the AS/SVE system in 2009.

The extent of the chlorobenzene plume has remained stable and concentrations are decreasing at several locations. Chlorobenzene was not detected above the MCL in the monitoring wells located downgradient of the OT41 groundwater extraction system. The groundwater extraction system is effective at capturing the chlorobenzene and benzene plumes and preventing their migration into Horse Creek, as well as minimizing adverse impacts to the adjacent wetlands.

It is estimated that 65 lbs of total organics were removed by the OT41 extraction wells during this reporting period, bringing the total to 634 lbs of total organics removed since system operations began in 2002.

In consideration of the observations presented above, it is recommended that the remedial approach at SWMU 61 be transitioned to MNA. The remedial system at OT41 continues to operate as intended, in accordance with its design criteria. As a result, no major structural or process modifications are anticipated during the upcoming year for OT41.

Based on the observations that COC concentrations have been below MCLs/RLs for a minimum of three consecutive sampling events at S61W1, S61W2, and S61W3, and consistent with the CAP requirements for this site, it is also recommended that groundwater monitoring from these wells be discontinued. Contaminant concentration trends will continue to be monitored at S61W4, at which one of the site's COCs remains slightly above the MCL. Considering that these benzene detections are only slightly above the MCL of 5 μg/L, no active remedial action is required, and it is anticipated that natural attenuation will be sufficient to meet the remedial objectives at this location. The contaminant concentrations in groundwater samples collected from monitoring wells located downgradient of the source area will continue to be monitored as part of the OT41 remedial strategy and reported as part of the Annual Progress Reports for the GWTS.

Groundwater Treatment Plant

The GWTP is designed to reduce the concentrations of TCE in groundwater pumped to the plant to below the current NPDES permit limit of 80.7 μg/L. Because the beneficiation processes involved are applicable to several classes of compounds, the GWTP also reduces the concentrations of other organic compounds.

During this reporting period, the GWTP operated in accordance with the O&M Plan, and within the NPDES permit requirements, with no planned or unplanned reportable shutdowns. Plant run-time and process reliability have been outstanding and remained so during this reporting period. The GWTP operated 361.6 days during this reporting period (more than 99 percent of the time). By 2010, the annual GWTP throughput rate [624.7 gallons per minute (gpm)] has progressively increased to more than triple the initial rate established after startup in 1997 (195.6 gpm).

No major structural or process modifications are anticipated during the upcoming year.

Overall Groundwater Treatment System

Approximately 323 million gallons of groundwater from the GWTS restoration sites were pumped to the GWTP during this reporting period. Roughly 81 percent of the flow was from groundwater systems associated with OT20 (51 percent) and OT17 (30 percent).

During this reporting period, an estimated 2,826 lbs of total organics mass were removed from the groundwater extracted from the GWTS sites. Approximately 97 percent of the total organics mass removed was from the groundwater extraction systems associated with LF03 (74 percent), OT20 (12 percent), and OT17 (11 percent). Even though LF03 contributed only seven percent of the flow during the most recent reporting period, the 77 percent total organics mass removed is the highest of the GWTS sites and demonstrates the mass removal efficiency of the groundwater extraction and leachate collection systems in place at the site. Since the start of the GWTS operation, 31,493 lbs (more than 15 tons) of total organics mass have been removed from groundwater, of which an estimated 46 percent has been comprised of TCE (14,604 lbs).

Additionally, the AS/SVE system at OT20, the SVE and gas collection system systems at LF03, and the SVE system at OT17 are operated in conjunction with the GWTS to increase the mass removed from the GWTS affiliated sites. At OT20, a total of 59 lbs of TCE and 491 lbs of total VOCs were removed during this reporting period by the AS/SVE system. Historically, the OT20 AS/SVE system has removed 827 lbs of TCE and 41,473 lbs of total VOCs. At LF03, a total of 19,256 lbs of organics was removed during this reporting period from the SVE and landfill gas collection systems. Of this mass, more than 92 percent was methane, with VOCs making up the remainder. Historically, the LF03 SVE and landfill gas collection systems have removed more than 127,498 lbs of organics, of which more than 96 percent was methane. At OT17, it is estimated that the SVE system removed 117 lbs of TCE during the current reporting period. Historically, it is estimated that approximately 3,814 lbs of TCE has been removed by the OT17 SVE system.

The achievements described herein are a direct reflection of Robins AFB's commitment to continual Remedial Process Optimization (RPO) efforts. They are even more remarkable in view of declining contaminant concentrations at the GWTS restoration sites and were made possible only by offsetting this decline with higher groundwater extraction rates, thereby accelerating site cleanup.

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TABLE OF CONTENTS

1.0 INTRODUCTION **1-1**
1.1 STATEMENT OF PURPOSE 1-1
1.2 CONTENT OF REPORT, REPORT CONVENTIONS, AND METHODOLOGY AND RATIONALE 1-2
1.2.1 Content of the Report 1-2
1.2.2 Report Conventions 1-4
1.2.3 Methodology and Rationale 1-8
2.0 GROUNDWATER TREATMENT SYSTEM (GWTS) **2-1**
2.1 GWTS OVERVIEW 2-1
2.1.1 Introduction 2-1
2.1.2 GWTS Location 2-2
2.1.3 GWTS Background 2-3
2.2 GWTS OPERATIONAL SETTING DURING REPORTING PERIOD 2-4
2.3 GENERAL BASEWIDE HYDROGEOLOGIC SETTING 2-7
3.0 SWMU 4/LF04 OU3 .... **3-1**
3.1 SWMU 4/LF04 OVERVIEW 3-1
3.1.1 Background 3-1
3.1.2 Site Hydrogeology and Conceptual Model 3-3
3.1.3 ROD Summary and Remedial System Description 3-4
3.2 SWMU 4/LF04 OPERATIONAL DATA 3-7
3.2.1 Groundwater Level Measurements 3-8
3.2.2 Groundwater Sampling 3-8
3.3 SWMU 4/LF04 REMEDIAL PERFORMANCE EVALUATION 3-9
3.3.1 Evaluation of Groundwater Flow 3-10
3.3.2 Evaluation of Remedial Progress 3-10

TABLE OF CONTENTS (Continued)

3.4 SWMU 4/LF04 CONCLUSIONS AND RECOMMENDATIONS 3-15
3.4.1 Conclusions 3-15
3.4.2 Recommendations 3-17
4.0 SWMU 20/OT20 4-1
4.1 SWMU 20/OT20 OVERVIEW 4-1
4.1.1 Background 4-1
4.1.2 Site Hydrogeology and Conceptual Model 4-3
4.1.3 Corrective Action Plan Summary and Remedial System Description 4-4
4.2 SWMU 20/OT20 OPERATIONAL DATA 4-7
4.2.1 Summary of Operation and Maintenance Activities 4-7
4.2.2 Operational Flow Rates 4-9
4.2.3 Remedial System Monitoring Data 4-10
4.3 SWMU 20/OT20 REMEDIAL PERFORMANCE EVALUATION 4-11
4.3.1 Evaluation of Groundwater Flow 4-12
4.3.2 Evaluation of Remedial Progress 4-12
4.4 SWMU 20/OT20 CONCLUSIONS AND RECOMMENDATIONS 4-18
4.4.1 Conclusions 4-18
4.4.2 Recommendations 4-20
5.0 SWMU 3/LF03 5-1
5.1 SWMU 3/LF03 OVERVIEW 5-1
5.1.1 Background 5-1
5.1.2 Site Hydrogeology and Conceptual Model 5-3
5.1.3 Corrective Action Plan Summary and Remedial System Description 5-5
5.2 SWMU 3/LF03 OPERATIONAL DATA 5-8
5.2.1 Summary of Operation and Maintenance Activities 5-8
5.2.2 Operational Flow Rates 5-12

TABLE OF CONTENTS (Continued)

5.2.3 Remedial System Monitoring Data 5-13
5.3 SWMU 3/LF03 REMEDIAL PERFORMANCE EVALUATION 5-16
5.3.1 Evaluation of Groundwater Flow 5-17
5.3.2 Evaluation of Remedial Progress 5-18
5.4 SWMU 3/LF03 CONCLUSIONS AND RECOMMENDATIONS 5-25
5.4.1 Conclusions 5-25
5.4.2 Recommendations 5-27
6.0 SWMUs 17 AND 24/OT17 6-1
6.1 SWMUs 17 AND 24/OT17 OVERVIEW 6-1
6.1.1 Background 6-1
6.1.2 Site Hydrogeology and Conceptual Model 6-3
6.1.3 Corrective Action Plan Summary and Remedial System Description 6-4
6.2 SWMUs 17 AND 24/OT17 OPERATIONAL DATA 6-6
6.2.1 Summary of Operation and Maintenance Activities 6-6
6.2.2 Operational Flow Rates 6-8
6.2.3 Supplementary Studies 6-9
6.2.4 Remedial System Monitoring Data 6-9
6.3 SWMUs 17 AND 24/OT17 REMEDIAL PERFORMANCE EVALUATION 6-12
6.3.1 Evaluation of Groundwater Flow 6-12
6.3.2 Evaluation of Remedial Progress 6-13
6.4 SWMUs 17 AND 24/OT17 CONCLUSIONS AND RECOMMENDATIONS 6-18
6.4.1 Conclusions 6-19
6.4.2 Recommendations 6-20

TABLE OF CONTENTS (Continued)

7.0 SWMU 62/OT37 7-1
7.1 SWMU 62/OT37 OVERVIEW 7-1
7.1.1 Background 7-1
7.1.2 Site Hydrogeology and Conceptual Model 7-2
7.1.3 Corrective Action Plan Summary and Remedial System Description 7-3
7.2 SWMU 62/OT37 OPERATIONAL DATA 7-4
7.2.1 Summary of Operation and Maintenance Activities 7-5
7.2.2 Operational Flow Rates 7-6
7.2.3 Remedial System Monitoring Data 7-6
7.3 SWMU 62/OT37 REMEDIAL PERFORMANCE EVALUATION 7-7
7.3.1 Evaluation of Groundwater Flow 7-7
7.3.2 Evaluation of Remedial Progress 7-8
7.4 SWMU 62/OT37 CONCLUSIONS AND RECOMMENDATIONS 7-10
7.4.1 Conclusions 7-10
7.4.2 Recommendations 7-11
8.0 SWMU 57/OT41 AND SWMU 61 8-1
8.1 SWMU 57/OT41 AND SWMU 61 OVERVIEW 8-1
8.1.1 Background 8-1
8.1.2 Site Hydrogeology and Conceptual Model 8-3
8.1.3 Corrective Action Plan Summary and Remedial System Description 8-5
8.2 SWMU 57/OT41 AND SWMU 61 OPERATIONAL DATA 8-7
8.2.1 Summary of Operation and Maintenance Activities 8-7
8.2.2 Operational Flow Rates 8-9
8.2.3 Remedial System Monitoring Data 8-9

TABLE OF CONTENTS (Continued)

8.3 SWMU 57/OT41 AND SWMU 61 REMEDIAL PERFORMANCE EVALUATION 8-10
8.3.1 Evaluation of Groundwater Flow 8-11
8.3.2 Evaluation of Remedial Progress 8-11
8.4 SWMU 57/OT41 AND SWMU 61 CONCLUSIONS AND RECOMMENDATIONS 8-16
8.4.1 Conclusions 8-16
8.4.2 Recommendations 8-18
9.0 GROUNDWATER TREATMENT PLANT (GWTP) 9-1
9.1 GWTP OVERVIEW 9-1
9.2 GWTP OPERATIONAL DATA AND PERFORMANCE EVALUATION 9-3
9.2.1 Operations Review 9-3
9.2.2 GWTP Flow Data 9-3
9.2.3 GWTP Influent and Effluent Analysis 9-4
9.2.4 GWTP Mass Removal Estimates 9-4
9.3 GWTP CONCLUSIONS AND RECOMMENDATIONS 9-5
9.3.1 Conclusions 9-5
9.3.2 Recommendations 9-6
10.0 GWTS – OVERALL SUMMARY AND CONCLUSIONS 10-1
10.1 REVIEW OF OVERALL GWTS FLOW TOTALS 10-1
10.2 OVERALL GWTS MASS REMOVAL TOTALS 10-1
10.3 COMPARISON OF GWTS VERSUS GWTP MASS REMOVAL TOTALS 10-3
10.4 CONCLUSIONS AND RECOMMENDATIONS 10-5
11.0 REFERENCES 11-1

LIST OF TABLES

Table No.

1-1	Historical Precipitation for Robins Air Force Base
3-1	Contaminants of Concern for LF04 OU3 (Groundwater)
3-2	Historical Annual Average Flow Rates for LF04 RW Series Wells
3-3	LF04 Well Construction Details and Groundwater Elevation Data
3-4	Summary Statistics for LF04 Groundwater Monitoring (2010)
3-5	Summary of Analytical Results for LF04 Groundwater Monitoring Wells (2010)
3-6	Summary of Contaminant-Specific Mass Removal Estimates for Entire LF04 Groundwater Recovery System
3-7	Summary of Total Organics Mass Removal Rates for LF04 Groundwater Recovery System Components
3-8	Summary of Geochemical Parameters and Chlorinated Ethenes in Groundwater at LF04
4-1	Contaminants of Concern for OT20 (Groundwater)
4-2	Historical Annual Average Flow Rates for OT20EW Series Wells
4-3	OT20 Well Construction Details and Groundwater Elevation Data
4-4	Summary Statistics for OT20 Groundwater Monitoring (2010)
4-5	Summary of Analytical Results for OT20 Groundwater Extraction System (2010)
4-6	Summary of Analytical Results for OT20 Groundwater Monitoring Wells (2010)
4-7	Summary of Contaminant-Specific Mass Removal Estimates for Entire OT20 Groundwater Extraction System
4-8	Summary of Total Organics Mass Removal Rates for OT20 Groundwater Extraction System Components
5-1	Contaminants of Concern for LF03 (Groundwater and Surface Water)
5-2	Historical Annual Average Flow Rates for LF3EW Series Wells, LF03 Interceptor Trench, and LF03 Transfer Pump Station
5-3	LF03 Well Construction Details and Groundwater Elevation Data
5-4	Water Levels Outside and Inside of Slurry Wall
5-5	Summary Statistics for LF03 Groundwater Monitoring (2010)
5-6	Summary of Analytical Results for LF03 Groundwater Extraction System (2010)
5-7	Summary of Analytical Results for LF03 Groundwater Monitoring Wells (2010)
5-8	Summary of Analytical Results for LF03 Surface Water Samples
5-9	Summary of Air Sampling Results for LF03 Soil Vapor Extraction (SVE) and Landfill Gas Flare Systems

LIST OF TABLES (Continued)

5-10	Summary of Contaminant-Specific Mass Removal Estimates for Entire LF03 Groundwater Extraction System
5-11	Summary of Total Organics Mass Removal Rates for LF03 Groundwater Extraction System Components
5-12	Summary of Analytical Results and Mass Removal Estimates for Cleanout of LF03 Transfer Station Sump
5-13	Mass Removal Estimates for LF03 Soil Vapor Extraction (SVE) and Landfill Gas Flare Systems
6-1	Contaminants of Concern for OT17 (Groundwater)
6-2	Historical Annual Average Flow Rates for OT17EW Series Wells
6-3	OT17 Well Construction Details and Groundwater Elevation Data
6-4	Summary Statistics for OT17 Groundwater Monitoring (2010)
6-5	Summary of Analytical Results for OT17 Groundwater Extraction System (2010)
6-6	Summary of Analytical Results for OT17 Groundwater Monitoring Wells (2010)
6-7	Summary of Air Sampling Results for OT17 Soil Vapor Extraction (SVE) System
6-8	Summary of Contaminant-Specific Mass Removal Estimates for Entire OT17 Groundwater Extraction System
6-9	Summary of Total Organics Mass Removal Rates for OT17 Groundwater Extraction System Components
6-10	TCE Mass Removal Rates for OT17 SVE System
7-1	Contaminants of Concern for OT37 (Groundwater)
7-2	Historical Annual Average Flow Rates for OT37EW Series Wells
7-3	OT37 Well Construction Details and Groundwater Elevation Data
7-4	Summary Statistics for OT37 Groundwater Monitoring (2010)
7-5	Summary of Analytical Results for OT37 Groundwater Extraction System (2010)
7-6	Summary of Analytical Results for OT37 Groundwater Monitoring Wells (2010)
7-7	Summary of Contaminant-Specific Mass Removal Estimates for Entire OT37 Groundwater Extraction System
7-8	Summary of Total Organics Mass Removal Rates for OT37 Groundwater Extraction System Components
8-1	Contaminants of Concern for OT41 and SWMU 61 (Groundwater)
8-2	Historical Annual Average Flow Rates for OT41EW Series Wells
8-3	OT41 and SWMU 61 Well Construction Details and Groundwater Elevation Data
8-4	Summary Statistics for OT41 and SWMU 61 Groundwater Monitoring (2010)

LIST OF TABLES (Continued)

8-5	Summary of Analytical Results for OT41 Groundwater Extraction System (2010)
8-6	Summary of Analytical Results for OT41 and SWMU 61 Groundwater Monitoring Wells (2010)
8-7	Summary of Contaminant-Specific Mass Removal Estimates for Entire OT41 Groundwater Extraction System
8-8	Summary of Total Organics Mass Removal Rates for OT41 Groundwater Extraction System Components
9-1	Historical Annual Average Flow Rates for the Groundwater Treatment Plant (GWTP)
9-2	Summary of Analytical Results for Groundwater Treatment Plant (GWTP) Influent
9-3	Summary of Analytical Results for Groundwater Treatment Plant (GWTP) Effluent
9-4	Summary of Contaminant-Specific Mass Removal Estimates for Groundwater Treatment Plant (GWTP)
9-5	Summary of Historic Contaminant-Specific Mass Removal Estimates for Groundwater Treatment Plant (GWTP)
10-1A	Summary of Monthly Flow Totals for Groundwater Treatment System (GWTS)
10-1B	Summary of Historic Annual Flow Totals for Groundwater Treatment System (GWTS)
10-2	Summary of GWTS Mass Removal Estimates for Dec 2009 – Nov 2010
10-3	Historical Mass Removal Estimates for GWTS Restoration Sites
10-4	Historical Cumulative Mass Removal Estimates for GWTS Restoration Sites

LIST OF FIGURES

Figure No.

2-1	Robins AFB Location Map
2-2	Robins AFB Facilities Map
2-3	GWTS Layout
2-4	Basewide Sampling Monitoring Well Network
2-5	General Basewide Hydrogeologic Setting
3-1A	LF04 Site Layout
3-1B	LF04 Site Layout – Monitoring and Recovery Well Network
3-2	LF04 Hydrogeologic Cross-Section
3-3	Potentiometric Map, Surficial Aquifer, SWMU 4/LF04
3-4	Potentiometric Map, Alluvial Aquifer, SWMU 4/LF04
3-5	Potentiometric Map, Upper Providence Aquifer, SWMU 4/LF04
3-6	Potentiometric Map, Lower Providence Aquifer, SWMU 4/LF04
3-7	TCE Concentrations, Alluvial Aquifer, SWMU 4/LF04
3-8	Historical TCE Concentrations, Alluvial Aquifer, SWMU 4/LF04
3-9A	Time Trend Contaminant Concentrations, Alluvial Aquifer – I, SWMU 4/LF04
3-9B	Time Trend Contaminant Concentrations, Alluvial Aquifer – II, SWMU 4/LF04
3-10	Investigation of Geochemical Parameters, SWMU 4/LF04
3-11	Distribution of Chlorinated Ethenes in Alluvial Aquifer, SWMU 4/LF04
4-1A	OT20 Site Layout
4-1B	OT20 Site Layout – Monitoring and Extraction Well Network
4-2	OT20 Hydrogeologic Cross-Section
4-3	Potentiometric Map, Upper Providence Aquifer, SWMU 20/OT20
4-4	Potentiometric Map, Lower Providence Aquifer, SWMU 20/OT20
4-5	TCE Concentrations, Top Upper Providence Aquifer, SWMU 20/OT20
4-6	Historical TCE Concentrations, Top Upper Providence Aquifer, SWMU 20/OT20
4-7	Time Trend Contaminant Concentrations, Top Upper Providence Aquifer, SWMU 20/OT20
4-8	TCE Concentrations, Middle Upper Providence/Alluvial Aquifers, SWMU 20/OT20
4-9	Historical TCE Concentrations, Middle Upper Providence/Alluvial Aquifers, SWMU 20/OT20
4-10	Time Trend Contaminant Concentrations, Middle Upper Providence/Alluvial Aquifers, SWMU 20/OT20

LIST OF FIGURES (Continued)

4-11	TCE Concentrations, Bottom Upper Providence Aquifer, SWMU 20/OT20
4-12	Historical TCE Concentrations, Bottom Upper Providence Aquifer, SWMU 20/OT20
4-13	Time Trend Contaminant Concentrations, Bottom Upper Providence Aquifer, SWMU 20/OT20
4-14	TCE Concentrations, Lower Providence Aquifer, SWMU 20/OT20
4-15	Historical TCE Concentrations, Lower Providence Aquifer, SWMU 20/OT20
4-16	Time Trend Contaminant Concentrations, Lower Providence Aquifer, SWMU 20/OT20
5-1A	LF03 Site Layout
5-1B	LF03 Site Layout – Monitoring and Extraction Well Network
5-2	LF03 Hydrogeologic Cross-Section
5-3	Surface Water Samples, SWMU 3/LF03
5-4A	Water Level Differentials Inside vs. Outside of Landfill, SWMU 3/LF03
5-4B	Cross-Sections of Water Levels Through Landfill, SWMU 3/LF03
5-5	Potentiometric Map – Pumping, Surficial Aquifer, SWMU 3/LF03
5-6	Chlorobenzene Concentrations, Surficial Aquifer, SWMU 3/LF03
5-7	Historical Chlorobenzene Concentrations, Surficial Aquifer, SWMU 3/LF03
5-8A	Time Trend Contaminant Concentrations Inside Slurry Wall, Surficial Aquifer, SWMU 3/LF03
5-8B	Time Trend Contaminant Concentrations East of Slurry Wall, Surficial Aquifer, SWMU 3/LF03
5-8C	Time Trend Contaminant Concentrations West of Slurry Wall, Surficial Aquifer, SWMU 3/LF03
6-1A	OT17 Site Layout
6-1B	OT17 Site Layout – Monitoring and Extraction Well Network
6-2	OT17 Hydrogeologic Cross-Section
6-3	Potentiometric Map, Unconfined Upper Providence Aquifer, SWMU 17/OT17
6-4	Potentiometric Map, Confined Upper Providence Aquifer, SWMU 17/OT17
6-5	TCE Concentrations, Unconfined Upper Providence Aquifer, SWMU 17/OT17
6-6	Historical TCE Concentrations, Unconfined Upper Providence Aquifer, SWMU 17/OT17
6-7	Time Trend TCE Concentrations, Unconfined Upper Providence Aquifer, SWMU 17/OT17

LIST OF FIGURES (Continued)

6-8	TCE Concentrations, Confined Upper Providence Aquifer, SWMU 17/OT17
6-9	Historical TCE Concentrations, Confined Upper Providence Aquifer, SWMU 17/OT17
6-10	Time Trend TCE Concentrations, Confined Upper Providence Aquifer, SWMU 17/OT17
6-11	3-D Representation of OT17 TCE Groundwater Plume
6-12A	Cross-Sections of OT17 TCE Groundwater Plume, Sections A-A' and B-B'
6-12B	Cross-Sections of OT17 TCE Groundwater Plume, Sections C-C' and D-D'
7-1A	OT37 Site Layout
7-1B	OT37 Site Layout – Monitoring and Extraction Well Network
7-2	OT37 Hydrogeologic Cross-Section
7-3	Potentiometric Map, Upper Providence Aquifer, SWMU 62/OT37
7-4	TCE Concentrations, Upper Providence Aquifer, SWMU 62/OT37
7-5	Historical TCE Concentrations, Upper Providence Aquifer, SWMU 62/OT37
7-6	Time Trend TCE Concentrations, Upper Providence Aquifer, SWMU 62/OT37
8-1	SWMU57/OT41 and SWMU 61 Site Layout – Monitoring and Extraction Well Network
8-2	SWMU57/OT41 and SWMU 61 Hydrogeologic Cross-Section
8-3	Potentiometric Map, Upper Providence Aquifer, SWMU 57/OT41 & SWMU 61
8-4	Potentiometric Map, Alluvial Aquifer, SWMU 57/OT41 & SWMU 61
8-5	Benzene Concentrations, Upper Providence/Alluvial Aquifers, SWMU 57/OT41 & SWMU 61
8-6	Historical Benzene Concentrations, Upper Providence/Alluvial Aquifers, SWMU 57/OT41 & SWMU 61
8-7	Time Trend Contaminant Concentrations, Upper Providence/Alluvial Aquifers, SWMU 57/OT41 & SWMU 61
8-8	Chlorobenzene Concentrations, Upper Providence/Alluvial Aquifers, SWMU 57/OT41 & SWMU 61
8-9	Historical Chlorobenzene Concentrations, Upper Providence/Alluvial Aquifers, SWMU 57/OT41 & SWMU 61
8-10	Time Trend Contaminant Concentrations, Upper Providence/Alluvial Aquifers, SWMU 57/OT41 & SWMU 61

LIST OF FIGURES (Continued)

9-1	Groundwater Treatment System, Process Flow Diagram
10-1	Flow and Mass Removal Contributions and Speciation of Organic Mass Removed
10-2	Summary of Historic Flow Data and Mass Removal Estimates

APPENDICES

Appendix A **Laboratory Certifications**

Appendix B **Groundwater Treatment System Flow Data**

B1 OT20 Extraction Well Flows (December 2009 - November 2010)
B2 LF03 Extraction Well Flows (December 2009 - November 2010)
B3 OT17 Extraction Well Flows (December 2009 - November 2010)
B4 OT37 Extraction Well Flows (December 2009 - November 2010)
B5 OT41 Extraction Well Flows (December 2009 - November 2010)
B6 GWTP Flows (December 2009 - November 2010)

Appendix C **Statistical Trend Analyses**

C1 Statistical Trend Analyses – Methodology
C2 LF04 – Statistical Trend Analysis Results
C3 OT20 – Statistical Trend Analysis Results
C4 LF03 – Statistical Trend Analysis Results
C5 OT17 – Statistical Trend Analysis Results
C6 OT37 – Statistical Trend Analysis Results
C7 OT41 and SWMU 61 – Statistical Trend Analysis Results

Appendix D **Groundwater Treatment System Mass Removal Data**

D1 Historical Mass Removal Estimates for LF04 Recovery Wells
D2 Historical Mass Removal Estimates for OT20 Extraction Wells
D3 Historical Mass Removal Estimates for LF03 Extraction Wells, Interceptor Trench, and Leachate Collection Wells
D4 Historical Mass Removal Estimates for OT17 Extraction Wells
D5 Historical Mass Removal Estimates for OT37 Extraction Wells
D6 Historical Mass Removal Estimates for OT41 Extraction Wells

Appendix E **LF03 Photographs**

Appendix F **OT17 Soil Vapor Extraction (SVE) System Information**

F1 OT17 SVE System Schematic Diagrams
F2 OT17 SVE System Photo Ionization Detector (PID) Readings (2010)

LIST OF ACRONYMS AND OFFICE SYMBOLS

3-D	Three-dimensional
78 CEG/CEAN	Environmental Management Branch of the 78th Civil Engineer Group
AFCEE	Air Force Center for Engineering and the Environment
AFMC	Air Force Materiel Command
As	Arsenic
AS	Air Sparge
AS/SVE	Air Sparge/Soil Vapor Extraction
bgs	below ground surface
BRA	Baseline Risk Assessment
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-DCE	Cis-1,2-dichloroethene
COCs	Contaminants of Concern
COD	Chemical Oxygen Demand
DLA	Defense Logistics Agency
DNAPL	Dense Non-aqueous Phase Liquid
DNR	Department of Natural Resources
DO	Dissolved Oxygen
EM	Environmental Management
ERP	Environmental Restoration Program
ES	Engineering Science, Inc.
EW	Extraction Well
FFA	Federal Facilities Agreement

LIST OF ACRONYMS AND OFFICE SYMBOLS (Continued)

FL	Florida
FPTA	Fire Protection Training Area
FS	Feasibility Study
ft	feet
ft^2	square feet
GAC	Granular Activated Carbon
GA EPD	Georgia Environmental Protection Division
GBIA	Greater Base Industrial Area
gpd	gallons per day
gpm	gallons per minute
GWTP	Groundwater Treatment Plant
GWTS	Groundwater Treatment System
HAZWRAP	Hazardous Waste Remedial Action Program
ICMs	Interim Corrective Measures
IMs	Interim Measures
IPC	Inclined Plate Clarifier
IROD	Interim Record of Decision
IRP	Installation Restoration Program
IWTP	Industrial Waste Treatment Plant
LA	Louisiana
Law	Law Environmental, Inc.
lbs	pounds
LCDA	Laboratory Chemical Disposal Area
LF03	Landfill No. 3
LF04	Landfill No. 4

LIST OF ACRONYMS AND OFFICE SYMBOLS (Continued)

LUCs	Land Use Controls
MCL	Maximum Contaminant Level
Mgal	Million Gallons
mg/L	milligrams per liter
MIP	Membrane Interface Probe
MNA	Monitored Natural Attenuation
MSL	Mean Sea Level
MVS	Mining Visualization System
NCP	National Contingency Plan
NFA	No Further Action
No.	Number
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation & Maintenance
ORP	Oxidation Reduction Potential
OT	Other Site
OU	Operable Unit
P&T	Pump and Treat
PCE	Tetrachloroethene or Perchloroethene
PDM	Programmed Depot Maintenance
PID	Photo Ionization Detector
POL	Petroleum, Oil, and Lubricants
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment

LIST OF ACRONYMS AND OFFICE SYMBOLS (Continued)

RFI	RCRA Facility Investigation
RI	Remedial Investigation
RL	Remedial Level
Robins AFB	Robins Air Force Base
ROD	Record of Decision
RPO	Remedial Process Optimization
RW	Recovery Well
scfm	standard cubic feet per minute
SVE	Soil Vapor Extraction
SVOC	Semi-volatile Organic Compound
SWMU	Solid Waste Management Unit
STP	Sanitary Treatment Plant
TCE	Trichloroethene/Trichloroethylene
TCL	Target Compound List
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
µg/L	micrograms per liter
USGS	United States Geological Survey
US EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UV-Ox	Ultraviolet Oxidation
VOC	Volatile Organic Compound
WP-14	Waste Pit 14
WR-ALC	Warner Robins Air Logistics Center
WS	Water Supply

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1.0 INTRODUCTION

1.1 STATEMENT OF PURPOSE

Robins Air Force Base (herein referred to as Robins AFB or the Base) owns and operates a Groundwater Treatment System (GWTS) within its borders. The GWTS is operated in a continuous mode by a contractor workforce under the direct supervision of Robins AFB personnel.

The GWTS is a pump and treat (P&T) remedial system that is used for the treatment of impacted groundwater from multiple sites on the Base. The GWTS primarily consists of: (i) groundwater extraction wells located at a number of widely dispersed environmental restoration sites; (ii) a centralized groundwater treatment plant (GWTP); and (iii) a network of conveyance piping to transfer the extracted groundwater from the restoration sites to the centralized GWTP. As currently configured, the GWTS facilitates the remediation of the following six sites:

- Solid Waste Management Unit Number (No.) 4 (SWMU 4)/Landfill No. 4 (LF04) Operable Unit 3 (OU3);
- SWMU 20/Other Site 20 (OT20);
- SWMUs 3, 6 & 13/Landfill No. 3 (LF03);
- SWMUs 17 & 24/OT17;
- SWMU 62/OT37; and
- SWMU 57/OT41 (OT41) & SWMU 61.

The purpose of this report is to document (for the period from December 2009 through November 2010): (i) the annual operation and maintenance (O&M) activities associated with the GWTS (including the restoration sites and the GWTP); and (ii) the remedial progress for each restoration site associated with the GWTS. It summarizes the relevant O&M data and sampling information for the reporting period. This report was prepared in general accordance with the

"Draft Final, Operation and Maintenance Manual for Solid Waste Management Unit (SWMU) 20/OT20 Corrective Action Plan; SWMU 4/LF04 OU3 Record of Decision; SWMU 3, SWMU 6, and SWMU 13/LF03, FT06, and WP13 Corrective Action Plan; SWMU 17 and 24/OT17 Corrective Action Plan; SWMU 57 and 61/OT41 Corrective Action Plan; SWMU 62/OT37 Corrective Action Plan; and Groundwater Treatment System" dated February 2005 [hereinafter referred to as the GWTS O&M Manual (Earth Tech, 2005)] and site-specific Record of Decision (ROD) and Corrective Action Plan (CAP) requirements.

1.2 CONTENT OF REPORT, REPORT CONVENTIONS, AND METHODOLOGY AND RATIONALE

1.2.1 Content of the Report

The content and organization of the remainder of this report is described below.

Section 2 – Groundwater Treatment System (GWTS): This section presents: (i) an overview of the GWTS; (ii) background (i.e., construction phases and GWTS components); and (iii) the general basewide geological and hydrological setting.

Section 3 – SWMU 4/LF04 OU3 (LF04): This section presents: (i) an overview of LF04 (i.e., background, site hydrogeology and conceptual model, ROD objectives, and remedial system description); (ii) LF04 operational data for the current reporting period; (iii) LF04 remedial performance evaluation; and (iv) conclusions and recommendations for LF04.

Section 4 – SWMU 20/OT20 (OT20): This section presents: (i) an overview of OT20 (i.e., background, site hydrogeology and conceptual model, CAP objectives, and remedial system description); (ii) OT20 operational data for the current reporting period; (iii) OT20 remedial performance evaluation; and (iv) conclusions and recommendations for OT20.

Section 5 – SWMUs 3, 6, & 13/LF03 (LF03): This section presents: (i) an overview of LF03 (i.e., background, site hydrogeology and conceptual model, CAP objectives, and remedial system description); (ii) LF03 operational data for the current reporting period; (iii) LF03 remedial performance evaluation; and (iv) conclusions and recommendations for LF03.

Section 6 – SWMUs 17 & 24/OT17 (OT17): This section presents: (i) an overview of OT17 (i.e., background, site hydrogeology and conceptual model, CAP objectives, and remedial system description); (ii) OT17 operational data for the current reporting period; (iii) OT17 remedial performance evaluation; and (iv) conclusions and recommendations for OT17.

Section 7 – SWMU 62/OT37 (OT37): This section presents: (i) an overview of OT37 (i.e., background, site hydrogeology and conceptual model, CAP objectives, and remedial system description); (ii) OT37 operational data for the current reporting period; (iii) OT37 remedial performance evaluation; and (iv) conclusions and recommendations for OT37.

Section 8 – SWMU 57/OT41 (OT41) & SWMU 61: This section presents: (i) an overview of OT41 and SWMU 61 (i.e., background, site hydrogeology and conceptual model, CAP objectives, and remedial system description); (ii) OT41 and SWMU 61 operational data for the current reporting period; (iii) OT41 and SWMU 61 remedial performance evaluation; and (iv) conclusions and recommendations for OT41 and SWMU 61.

Section 9 – Groundwater Treatment Plant (GWTP): This section presents: (i) an overview of the GWTP; (ii) GWTP operational data for the current reporting period; (iii) GWTP performance evaluation; and (iv) conclusions and recommendations for the GWTP.

Section 10 – GWTS Summary and Conclusions: This section presents the general conclusions and recommendations related to the overall operation of the GWTS.

Section 11 – References: This section presents the references used in the preparation of this report.

1.2.2 Report Conventions

In multiple sections of this report, there are several types of information presented from the same source or with the same conditions or context. To enhance the reviewer's ability to proceed without encountering the restatement of information sources, conditions, or other repeated information, this section collects the most prominent commonalities and presents them once as conventions. Also, new terminology presented for the first time is noted herein. Key conventions herein include the following:

- *Program naming* – To be consistent with current Air Force terminology, the Installation Restoration Program (IRP) has been renamed the Environmental Restoration Program (ERP) throughout this document. Documents referenced as prepared prior to the change in terminology are referenced by the terminology in use at the time of document completion.
- *Approximations and data rounding for text discussions* – Data transcriptions from tables to text for discussion and comparison purposes are often intentionally truncated or rounded. Often, although not always, the text indicates "approximately" in such cases. Data rounding aids in presentation of information where approximate values are more useful for comparison than exact numbers. An example of this application is in well flow rates and mass removal rates, where the data are better presented for comparison purposes using approximations rather than exact data, valid to several decimal places, directly transcribed from a table.
- *Chemical contaminant naming* – Key contaminants that are encountered numerous times in most text discussions are typically abbreviated (TCE for trichloroethene or trichloroethylene, cis-DCE for cis-1,2-dichloroethene, and PCE for perchloroethene or tetrachloroethene.) Other contaminants, although encountered multiple times (e.g., vinyl chloride and chloroform), are not abbreviated. Chemical symbols or formulas (e.g., As for arsenic) are typically not used.

- *Average flow rate data* – The flow rate data are generally based on the average flow rate for a given period (i.e., total flow divided by total time duration, or effective flow rate) unless otherwise specified. The instantaneous flow rate for an operating pump will be higher than the reported average (effective) flow rate and may reflect the equipment capability (i.e., pump capacity) more accurately. However, the instantaneous flow rate of the pump does not reflect the true operational conditions of a well, as there are a number of other factors that significantly influence the rate of groundwater recovery and extraction (e.g., pump placement in the well and operational cycling, well screen type and construction methods, aquifer conditions, groundwater recharge, and system backpressure). Therefore, average flow rates are typically used in monitoring and evaluation of the operational conditions of remedial systems.
- *Groundwater elevation data* – Unless otherwise noted, the source of the groundwater elevation data is the *"Final Basewide Groundwater Sampling, Spring 2010"* (AECOM, 2010). Groundwater elevations within active recovery wells (RWs) and extraction wells (EWs) continually change with time due to pump cycling. Therefore, the measured groundwater levels for these locations are not reported herein, unless otherwise noted.
- *Groundwater analytical data sources and summary presentation in tables* – Unless otherwise indicated, the source of the groundwater analytical data is the *"Final Basewide Groundwater Sampling, Spring 2010* (AECOM, 2010). For each site, tabular data summary presentations have been compiled and are presented for the purpose of facilitating discussion of the various evaluations and syntheses made. These summary tables, unless otherwise indicated, include only the parameters that are detected during the current reporting period and do not include other parameters analyzed for, but not detected. The values reported in bold text in the tables indicate that the parameter is detected at or above the laboratory detection limit, and values

reported in bold text and shaded indicate that the parameter is detected at or above the respective Maximum Contaminant Level (MCL) or Remedial Level (RL) value specified by the appropriate regulatory document (CAP or ROD).

- *Trend analysis* – Throughout the discussions of individual site data, statistical evaluations of data trends have been made to enable enhanced understanding of plume conditions and to evaluate the performance of the remediation systems. Unless stated otherwise, the methodology employed for these evaluations is the nonparametric Mann-Kendall test method.
- *Mass removal estimates, GWTS restoration sites* – Mass removal estimates were calculated by averaging the concentrations representative of the reporting period and multiplying this average concentration by the total flow for the reporting period. With this approach, variability in the number of samples, sampling frequencies, elapsed time between sampling events, flow rates, and operational downtimes are normalized over a period of one year (i.e., reporting period). For mass removal estimates, only the eight most prevalent volatile organic compounds (VOCs) (i.e., 1-2-dichlorobenzene, 1-4-dichlorobenzene, benzene, chlorobenzene, cis-DCE, PCE, TCE, and vinyl chloride) were selected, based on an evaluation of the data collected from the GWTS in its entirety. On a site specific basis, other contaminants of concern (COCs) may have been detected and contributed to overall mass removal, but contributions of these other COCs were assumed to be negligible when compared to the more prevalent COCs.
- *Mass removal estimates, GWTP* – Mass removal estimates were calculated by averaging the concentrations representative of a given month and multiplying this average concentration by the total flow for that given month. The reason for using monthly averages (unlike the annual averages used for the restoration sites) is that more frequent sampling (i.e., twice a month versus one to three times a year) is performed at the GWTP. To remain consistent with the mass removal estimates from

the GWTS restoration sites, the eight VOCs listed in the previous bullet were selected for the GWTP mass removal estimate calculations. Other COCs were detected and contributed to overall mass removal, but the contributions of these other COCs were assumed to be negligible when compared to the more prevalent COCs.

- *GWTS and GWTP shutdowns* – There are two types of shutdowns: (i) reportable shutdowns; and (ii) other temporary shutdowns or downtimes related to minor maintenance activities. Reportable shutdowns are defined in the GWTS O&M Manual (Earth Tech, 2005) as: (i) for the GWTP, a major breakdown or complete failure for a duration of more than 24 hours; and (ii) for each of the GWTS sites, a mechanical or electrical failure that results in a reduction of flow to levels of 25 percent or less of the flow during normal operating conditions for a duration of more than 24 hours. Reportable shutdowns require notification to the appropriate regulatory agency. Other temporary shutdowns or downtimes related to routine O&M activities that do not meet the criteria listed above do not require notification.
- *Rainfall data* – Precipitation has a primary and direct influence on the average annual flow rates for the GWTS wells. Additionally, periods of excess rainfall or drought can affect contaminant concentrations. To allow for complete evaluation of the data over time with respect to precipitation, Table 1-1 has been prepared to present the annual precipitation for each reporting period since the GWTS began operation. Rainfall data in the table, as well as presented elsewhere in this report, were obtained from direct communication with the Robins AFB Weather Center.
- *Operations and maintenance of GWTS wells* – Throughout the year, activities are continually conducted at the GWTS wells to maintain extraction rates at an optimum level. These activities commonly consist of either well rehabilitation efforts or pump optimization. Well rehabilitation typically consists of addition of a reagent to the well to mitigate biofouling. Pump optimization commonly consists of replacing the pump, motor, or associated piping in kind; replacing the pump, motor, or associated

piping with a higher or lower capacity system; lowering or raising the pump; replacing the valves; etc.

1.2.3 Methodology and Rationale

The methodology and rationale employed in the development of the individual restoration site sections were as follows. For each site, a complete and thorough review of historic and current reporting year information, data, photographs (as appropriate and available), and other resources was conducted. Following this review, an evaluation and a synthesis of the historic and current data were conducted to evaluate the remedial performance of each site in the context of remedial objectives set forth by the respective ROD or CAP.

This methodology is consistent with the approach described for Remedial Process Optimization (RPO) Phase I programs detailed in the Air Force Center for Engineering and the Environment (AFCEE) and Defense Logistics Agency (DLA) publication entitled, "*Remedial Process Optimization Handbook*" dated June 2001 (AFCEE, 2001).

TABLE

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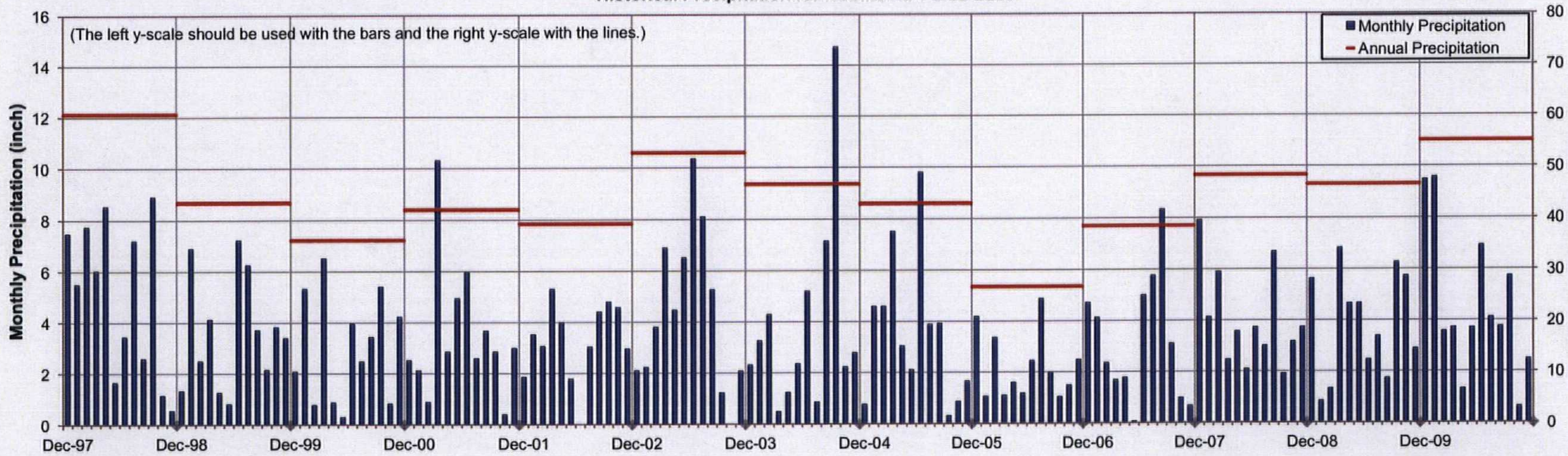
Table No. 1-1
Historical Precipitation for Robins Air Force Base

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

Reporting Period	Total Annual Precipitation (inches)	Monthly Precipitation during Reporting Period (inches) [(1), (2)]											
		December	January	February	March	April	May	June	July	August	September	October	November
Dec 2009 - Nov 2010	55.1	9.48	9.57	3.58	3.72	1.33	3.71	6.93	4.12	3.77	5.74	0.64	2.49
Dec 2008 - Nov 2009	46.5	5.64	0.86	1.34	6.82	4.66	4.68	2.47	3.40	1.75	6.27	5.74	2.90
Dec 2007 - Nov 2008	48.4	7.91	4.13	5.90	2.47	3.58	2.10	3.73	3.01	6.68	1.92	3.18	3.74
Dec 2006 - Nov 2007	38.6	4.71	4.12	2.36	1.69	1.78	0.06	5.00	5.76	8.32	3.11	0.98	0.67
Dec 2005 - Nov 2006	26.8	4.18	1.06	3.36	1.10	1.61	1.18	2.45	4.87	1.99	1.04	1.49	2.48
Dec 2004 - Nov 2005	43.1	0.76	4.60	4.60	7.51	3.04	2.10	9.80	3.88	3.92	0.30	0.87	1.67
Dec 2003 - Nov 2004	46.9	2.31	3.26	4.28	0.49	1.24	2.36	5.20	0.86	7.14	14.71	2.23	2.78
Dec 2002 - Nov 2003	53.0	2.10	2.23	3.80	6.89	4.47	6.52	10.36	8.09	5.26	1.22	0.00	2.08
Dec 2001 - Nov 2002	39.3	1.86	3.53	3.06	5.30	3.99	1.78	--	3.04	4.41	4.79	4.58	2.96
Dec 2000 - Nov 2001	42.1	2.52	2.11	0.87	10.31	2.86	4.94	5.97	2.59	3.66	2.86	0.39	2.99
Dec 1999 - Nov 2000	36.2	2.08	5.32	0.77	6.51	0.87	0.29	3.96	2.47	3.43	5.41	0.82	4.22
Dec 1998 - Nov 1999	43.4	1.33	6.89	2.49	4.12	1.26	0.81	7.21	6.24	3.70	2.15	3.83	3.40
Dec 1997 - Nov 1998	60.7	7.48	5.50	7.74	6.03	8.52	1.65	3.44	7.19	2.57	8.89	1.14	0.54
Oct 1997 - Nov 1997												6.19	7.28

Note:
-- Data not reported by Robins AFB Weather Center.
(1) Precipitation data are reported beginning October 1997, which represents the startup of the Groundwater Treatment Plant (GWTP) and associated Groundwater Treatment System (GTWS).
(2) Precipitation data were obtained from the Robins AFB Weather Center.

Historical Precipitation for Robins Air Force Base*



* Data graphed beginning December 1997 (i.e., the beginning of the first full reporting period).

GA100539
2010.1-1 HistPrecipitation.xlsx

2.0 GROUNDWATER TREATMENT SYSTEM (GWTS)

This section presents: (i) an overview of the GWTS (i.e., introduction, location, and background); (ii) the GWTS current operational setting; and (iii) the general basewide hydrogeologic setting.

2.1 GWTS OVERVIEW

2.1.1 Introduction

Robins AFB is located in central Georgia, approximately 18 miles south of Macon, Georgia. The Robins AFB property encompasses an area of 8,435 acres and occupies a large portion of the Ocmulgee River terrace and floodplain of northeastern Houston County (Figure 2-1). As one of the most active Air Force Materiel Command (AFMC) bases, Robins AFB, through its host unit, the Warner Robins Air Logistics Center (WR-ALC), performs Programmed Depot Maintenance (PDM) and other support activities on a variety of aircraft. The Base consists of 3.8 million square feet (ft^2) of maintenance shops, 1.7 million ft^2 of administrative space, and 3.5 million ft^2 of storage space (Figure 2-2). The Base's runway is the largest in Georgia, measuring 12,000 feet (ft) long by 300 ft wide, with two 1,000-ft overruns. Robins AFB houses a community that in 2010 included 259 family housing units and nine dormitories.

Because of the numerous and complex operations performed at the installation, Robins AFB encounters a significant number of ongoing and one-time environmental issues and concerns, including: compliance, restoration, sampling, pollution prevention, natural and cultural resources, and public interaction. As part of the aggressive and proactive approach taken by Robins AFB to manage these environmental issues, the former Environmental Management Directorate (EM), now the Environmental Management Branch of the 78th Civil Engineer Group (78 CEG/CEAN), investigated potentially contaminated sites, identified a number of sites that required corrective action, evaluated alternative remedial technologies, and developed corrective action strategies for each site.

During the mid-1990s, an evaluation of remedial alternatives for groundwater contamination at several sites was performed. The result of this evaluation was a decision to design, construct, and operate a multi-site (basewide) P&T system as the primary remediation strategy. The system was designed so that the P&T system could be supplemented on an as-needed basis with other remediation technologies [e.g., air sparge (AS), soil vapor extraction (SVE), monitored natural attenuation (MNA), enhanced bioremediation, etc.] in localized areas. The P&T system (herein referred to as the GWTS) consists of the following key components: (i) strategically placed groundwater recovery and extraction wells and leachate collection wells located at various restoration sites; (ii) a network of conveyance piping (or force main); and (iii) a centralized GWTP, which receives and treats the groundwater extracted from various restoration sites prior to discharge. A basewide GWTS with a centralized GWTP was shown to have a significant life-cycle cost-savings potential to the government when compared to the life-cycle cost for distributed treatment systems located at each restoration site.

2.1.2 GWTS Location

The GWTS stretches throughout the Base from the north (industrial and flightline areas) to the south (residential and recreational areas). The GWTP is centrally located east of the Greater Base Industrial Area (GBIA) at 780 Richard Ray Boulevard, Building 358. Figure 2-3 shows the GWTS as currently configured, including the locations of the GWTP, associated restoration sites, and the network of conveyance piping. Figure 2-4 presents the monitoring well network for the basewide sampling event, along with a generalized depiction of the groundwater contaminant plume for the primary contaminant of concern at each of the GWTS sites based on the data collected in the spring of 2010.

2.1.3 GWTS Background

Robins AFB began operation of the GWTS in October 1997. Initially, the GWTS was designed and constructed to support the remedial activities associated with two restoration sites (i.e., OT20 and LF04). The initial design, referred to as the Phase I Project, included: (i) six groundwater recovery wells and four leachate collection sumps (toe drains) at LF04; (ii) four interim measure "hot spot" groundwater extraction wells at OT20; (iii) a centralized GWTP with a treatment capacity of 300 gallons per minute (gpm); and (iv) a network of underground, dual-walled conveyance piping from these two sites to the GWTP. Additionally, the decontamination pad located off Richard Ray Boulevard (north of the LF04 main entrance gate) was connected to the GWTP to pump and treat potentially impacted water from decontamination activities and/or investigation-related activities. The Phase I design included sufficient flexibility for potential future expansion in anticipation of bringing other restoration sites online. Since its startup in 1997, the GWTS has been expanded several times, as described below.

The Phase II (Mega) project (completed in May 2000) expanded the GWTS to collect and treat groundwater from two additional restoration sites (i.e., LF03 and OT17). The expansion included: (i) nine groundwater extraction wells, one groundwater interceptor trench, and five leachate collection wells at LF03; (ii) five groundwater extraction wells (i.e., four vertical wells and one horizontal well) at OT17; (iii) a capacity increase to 900 gpm at the GWTP; and (iv) the expansion of the conveyance piping network to support the added extraction systems. Additionally, the expansion design provided a means to pump condensate from the LF03 gas collection system directly to the GWTP.

The Phase III project (completed in July 2002) further expanded the GWTS to collect and treat groundwater from two more restoration sites (OT37 and OT41) and also included an expansion of the OT20 extraction system. The expansion included: (i) two groundwater extraction wells at OT37; (ii) four groundwater extraction wells at OT41; (iii) seven additional groundwater extraction wells at OT20 (for a total of 11 extraction wells there); and (iv) the extension of the conveyance piping network to link these wells to the GWTP.

In 2007, the Base expanded the LF03 and OT20 extraction systems by adding one additional extraction well at both sites (i.e., LF3EW10 at LF03 and OT20EW12 at OT20). Both wells began operation on 17 May 2007. The extraction system at LF03 was further expanded in 2007 to include five dual-phase (vapor and leachate) extraction wells installed within the area contained by the LF03 slurry wall. Operation of these five extraction wells began on 25 June 2008.

2.2 GWTS OPERATIONAL SETTING DURING REPORTING PERIOD

As configured during the reporting period, operation of the GWTS included the following major components and processes.

- LF04 –
    - The groundwater recovery system at LF04 was shut down, with regulatory approval, on 1 February 2007 to evaluate the suitability of MNA as an alternative remedial approach for the site. In 2010, the United States Environmental Protection Agency (US EPA) (in a 26 May 2010 letter from Hugh Hazen of the US EPA to Fred Otto of Robins AFB) and the Georgia Department of Natural Resources (DNR), Environmental Protection Division (GA EPD) (in a 6 July 2010 letter from Amy Potter of the GA EPD to Mark Summers of Robins AFB) approved the transition of the site remedy to MNA. As part of routine maintenance, the site recovery wells are operated periodically to maintain them in an operational condition in the event that they need to be reactivated.
    - Decontamination water and investigation derived waste (liquid) collected at the decontamination pad.

- OT20 –
    - Nine groundwater extraction wells (OT20EW1, OT20EW2, and OT20EW6 through OT20EW12). [Note: Pumping from OT20EW3, OT20EW4, and OT20EW5 was discontinued, with regulatory approval, on 8 November 2006.]
    - Groundwater and condensate collected by an SVE system.
- LF03 –
    - Seven groundwater extraction wells (LF3EW3 through LF3EW7A, LF3EW9, and LF3EW10). [Note: LF3EW1 and LF3EW2 were shut down, with regulatory approval, on 7 January 2002 and 8 November 2006, respectively. LF3EW8 was shut down, with regulatory approval, on 23 April 2009).]
    - One interceptor trench (LF03 Interceptor Trench). [Note: The LF03 Interceptor Trench was shut down, with regulatory approval, on 23 April 2009. However, the pump in the trench is periodically operated to remove groundwater that accumulates in the trench.]
    - Five leachate collection wells (LF3LC1A through LF3LC5A). [Note: In March 2003, the leachate collection wells originally designated as LF3LC1 through LF3LC5 were replaced by new wells (in the same vaults) that extended to the top of the confining clay layer; hence, the initial designation was appended with an "A"].
    - Leachate collection from five dual-phase (vapor and leachate) extraction wells installed within the area contained by the LF03 slurry wall began on 25 June 2008.
    - Condensate collected by the landfill gas collection and SVE systems.

- OT17 –
  - Three vertical groundwater extraction wells (OT17EW2, OT17EW4, and OT17EW5). [Note: Pumping from OT17EW1 has been discontinued, with regulatory approval, since 23 August 2004.]
  - One horizontal groundwater extraction well (OT17EW3).
- OT37 –
  - One groundwater extraction well (OT37EW2). [Note: OT37EW1 was shut down, with regulatory approval, on 23 April 2009).]
- OT41 and SWMU 61 –
  - Three groundwater extraction wells (OT41EW1 through OT41EW3). [Note: Pumping from OT41EW4 was discontinued, with regulatory approval, on 7 August 2007.]
- GWTP –
  - Treatment flow capacity: 900 gpm.
  - Primary process steps at the GWTP include: clarification, equalization, pH adjustment, filtration, chemical/ultraviolet oxidation, granular activated carbon treatment, neutralization, and discharge monitoring.
  - The GWTP is linked to the restoration sites by miles of force main piping that carry contaminated groundwater from them to the plant for processing and by a fiber optics network that enables real time communications with, and monitoring of equipment at, these sites.
  - In addition to groundwater received from the restoration sites, the GWTP also receives potentially impacted decontamination water and investigation derived waste (liquid) collected at the LF04 decontamination pad or by direct delivery.

The operational and performance details of each of these components are discussed further in subsequent sections.

2.3 GENERAL BASEWIDE HYDROGEOLOGIC SETTING

Robins AFB is underlain by Coastal Plain Physiographic Province sedimentary formations of mainly Quaternary and Cretaceous age overlying a basement complex of Paleozoic metamorphic rocks. The Cretaceous sediments dip and thicken to the southeast at a slope of 20 to 30 ft per mile. Based on regional information provided by the United States Geological Survey (USGS), in the vicinity of the Base, the crystalline basement is estimated to be approximately 700 ft deep (Clarke et al., 1985).

Three Cretaceous geologic units have been recognized at Robins AFB, including, from oldest to youngest: the Eutaw-Blufftown Formation (Blufftown), the Cusseta Formation, and the Ripley-Providence Formation (Providence). The older Tuscaloosa Formation may be present beneath the Blufftown at the Base, but no confirming borehole data are available.

The Blufftown Formation consists primarily of white-to-buff colored, medium-to-coarse, moderately well-sorted sand with intercalated kaolinitic clay lenses and sparse gravel. The upper surface of the unit outcrops in the Echeconee Creek area northwest of the Base, but reportedly dips to nearly 400 ft below ground surface (bgs) at the southern boundary of the Base. In the vicinity of the Base, the Blufftown Formation has a thickness of approximately 350 to 400 ft.

The overlying Cusseta Formation is finer-grained than the Blufftown and is comprised of gray-brown to bluish-gray, and/or reddish colored slightly micaceous, stiff, clay and sandy clay. In some areas of the Base, two relatively continuous clay layers, separated by an intervening middle sandy unit, define the top and bottom of the formation. The Cusseta is often recognizable on borehole geophysical logs by a lower resistivity value and increased gamma count induced by the clay layers. In places, nearly half of the unit thickness may be composed of clay. The estimated thickness of the Cusseta Formation is approximately 100 ft in the vicinity of the Base.

Previous investigators assigned the uppermost Cretaceous deposits at the Base to the Ripley-Providence Formation. Although the Ripley and Providence Formations are distinctly separate units at other locations, the units are indistinguishable at the Base and, therefore, are combined as the Ripley-Providence Formation (Providence). This unit is comprised of cross-bedded, tan to red-brown, fine to coarse, sand and clayey sands interbedded with lenses of white, tan, and light purple kaolinitic clay. The formation is exposed in outcrops along the western side of the Base, except in areas where it is covered by fill or by floodplain deposits that veneer most of the area beneath the runway and flightline areas. Discontinuous clay lenses are present within the Providence Formation. The thickness of the Providence Formation beneath the Base ranges from 80 to 150 ft.

Quaternary deposits include a variety of surficial fluvial sediments associated with terraces of the Ocmulgee River system, including fluvial gravel, sand, clay, silt, and peat. These deposits range from a few feet to as much as 30 ft thick and cover the eastern surface area of the Base. In many areas, Quaternary alluvial deposits are essentially indistinguishable from the underlying Cretaceous deposits because they mainly consist of these deposits, reworked.

Though each is not everywhere present, in descending order, the following principal hydrogeologic units underlie Robins AFB (Figure 2-5):

- surficial aquifer;
- Quaternary alluvial aquifer;
- upper Providence aquifer;
- lower Providence aquifer;
- Cusseta aquitard; and
- Blufftown aquifer.

Wells classified as "surficial" at several locations on the Base are screened locally in refuse or fill materials that overlie the Quaternary alluvial or the upper Providence aquifers. Groundwater within the surficial materials forms localized distinct hydrogeologic units (herein referred to as surficial aquifers). Surficial aquifers are present at several sites at the Base, including LF03 and LF04.

The Quaternary alluvial aquifer consists of peat, clay, sand, and gravel layers that overlie the Providence aquifer in the Ocmulgee River floodplain. The Quaternary aquifer is exposed along the east side of the Base, generally in the area designated as wetlands, and pinches out to the west along a line roughly parallel to the western edge of OT41 and LF04. The western extent of the alluvial aquifer is represented on relevant figures by a green dashed line labeled "Approximate Quaternary Alluvium Contact." In most areas, the alluvium is in direct hydraulic communication with the underlying Providence aquifer and, typically, it is difficult to distinguish between these two units based on lithology.

The Providence aquifer consists of fine to coarse-grained sand with interlayered silt and clay. This aquifer outcrops over the west side of the Base and underlies the alluvial aquifer to the east. The Providence aquifer is subdivided into upper and lower units, primarily based on the aquifer thickness, to facilitate discussions of hydrogeology and the extent of groundwater contaminant plumes. The division between the upper and lower Providence aquifers has been arbitrarily assigned an elevation range of 180 to 210 ft above Mean Sea Level (MSL). In addition, the upper Providence is further divided into three subunits designated as "top", "middle", and "bottom" zones for the purpose of contaminant plume mapping and discussion purposes at two sites (i.e., OT20 and OT41) based on terminology provided in the respective CAPs. While the Providence aquifer is an important drinking water supply in areas down dip from the Base, where the formation thickens, it is not used for drinking water supply at the Base or in the immediate vicinity of the Base.

Below the Providence aquifer is the Cusseta, which acts as an aquitard to the underlying Blufftown aquifer. The Cusseta is reported to include two layers of clay, each 10 to 50 ft thick, separated by a sandy zone 30 to 75 ft thick.

The Blufftown aquifer, comprised of the Eutaw-Blufftown geologic formation, forms an exceptionally thick unit (thought to exceed 350 ft of productive aquifer). Potable and process water is produced from the Blufftown aquifer using water-supply wells at the Base. The reported yield of some of the production wells is more than 1,000 gpm.

Regional groundwater flow at the Base is typically from west to east toward the Ocmulgee River floodplain. In surficial aquifers at the Base, the potentiometric surface is represented by the water table, which generally mimics the surface topography. Groundwater flow in the upper Providence aquifer is from west to east, and it eventually either underflows or discharges vertically upward into the Quaternary alluvial aquifer to the east, which is approximately 20 to 30 ft thick in this vicinity. Groundwater flow in the Quaternary alluvial aquifer is from west to east, generally the same as in the upper Providence aquifer. Groundwater movement in the lower Providence and Blufftown aquifers is similar to that described for the upper Providence aquifer.

Along the western half of the Base (the recharge area), a downward gradient occurs between the upper and lower Providence and, to a lesser extent, between the lower Providence and Blufftown aquifers. Vertical movement between strata is restricted by locally discontinuous clay units that occur throughout the Providence formation. The clay units within the Cusseta form an aquitard, which impedes the amount of groundwater flow between the Providence and Blufftown aquifers. Along the eastern side of the Base, near the Ocmulgee River floodplain, upward flow occurs from the lower Providence and Blufftown aquifers into the shallower overlying aquifers.

FIGURES

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ROBINS AFB BOUNDARY

NOTE:
1. AERIAL PHOTOGRAPH DATE: SEPTEMBER 2009.

0 1,400 2,800 5,600 Feet

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG2-1.MXD		
PREPARED BY	CN	DATE:	12/14/2010
CHECKED BY	TH	DATE:	01/05/2011

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

PROJECT NAME: GWTS ANNUAL PROGRESS REPORT DEC 2009 - NOV 2010

SITE DESCRIPTION: ROBINS AFB, GEORGIA

FIGURE DESCRIPTION: ROBINS AFB LOCATION MAP

FIGURE NO. 2-1

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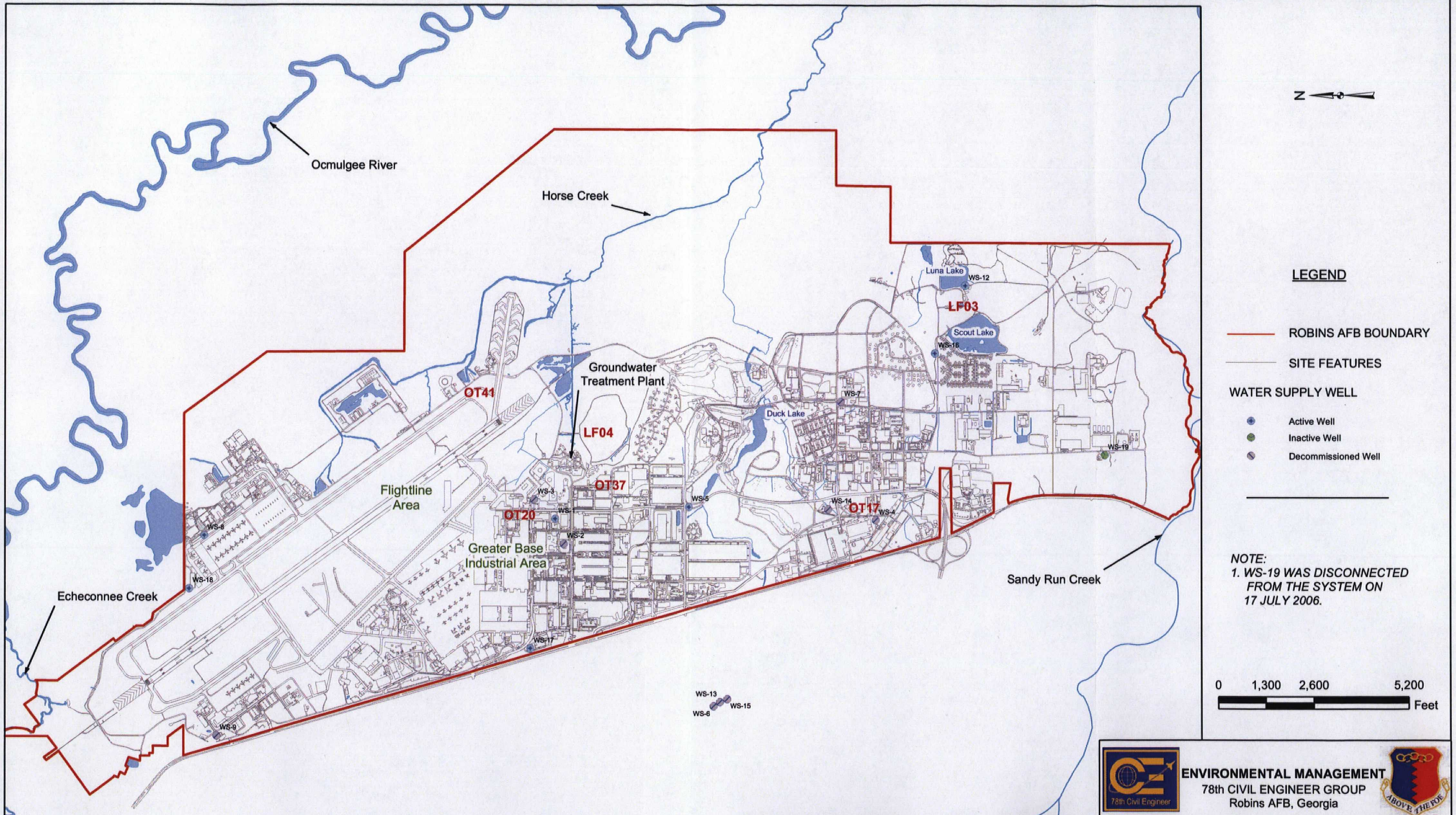

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG2-2.MXD		
PREPARED BY	CN	DATE:	12/14/2010
CHECKED BY	TH	DATE:	01/05/2011

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
ROBINS AFB FACILITIES MAP

FIGURE NO.
2-2

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U.S. EPA REGION IV

SDMS

Unscannable Material Target Sheet

DocID: 10994102 Site ID: GA1570024330

Site Name: Robbins Air Force

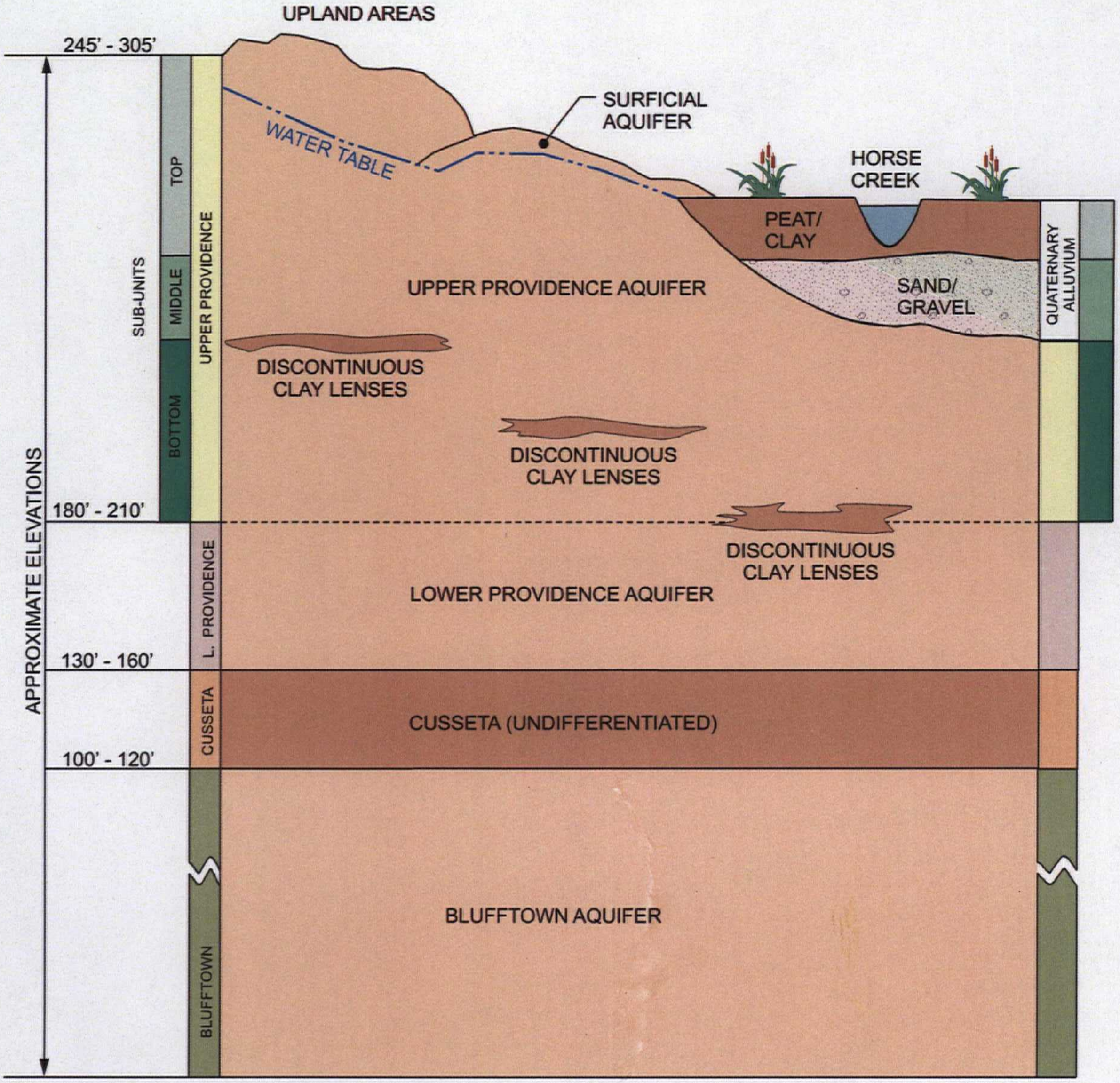
Nature of Material:

Map:	☑	Computer Disks:	☐
Photos:	☐	CD-ROM:	☐
Blueprints:	☐	Oversized Report:	☐
Slides:	☐	Log Book:	☐

Other (describe): Site Map

Amount of material:

* Please contact the appropriate Records Center to view the material *



NOT TO SCALE

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG 2-5.CDR		
PREPARED BY	CN	DATE	01/05/2011
CHECKED BY	TH	DATE	01/05/2011

PREPARED FOR

PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
GENERAL BASEWIDE HYDROGEOLOGIC SETTING

FIGURE NO.
2-5

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3.0 SWMU 4/LF04 OU3

SWMU 4/LF04 was designated as a National Priorities List (NPL) site consisting of two ERP sites: (i) LF04; and (ii) Sludge Lagoon Waste Pit 14 (WP14). The NPL site was initially divided into three OUs: (i) OU1 was defined as the LF04 and WP14 source areas; (ii) OU2 was defined as the wetlands and surface water impacted by the OU1 source areas; and (iii) OU3 was defined as the groundwater impacted by the OU1 sources areas. OU2 was later determined to not be associated with contaminants from LF04 (US EPA Position Letter Operable Unit 2, Wetlands, Robins AFB, Warner Robins, Georgia, August 2003); and therefore, OU2 is no longer a part of the NPL site and was addressed separately under the Resource Conservation and Recovery Act (RCRA) regulations delegated to the state of Georgia. The GA EPD granted OU2 tentative No Further Action (NFA) status on 12 April 2005 and final NFA status when the Robins AFB's Hazardous Waste Permit was updated on 29 September 2006. OU2 is not further discussed herein. This section of the Annual Report primarily focuses on groundwater impacted by LF04 and WP14 (i.e., OU3). Throughout the remainder of this document, SWMU 4/LF04 is referred to as LF04.

This section presents: (i) an overview of LF04 (i.e., background, hydrogeology and conceptual model, ROD summary, and remedial system description); (ii) operational data pertinent to LF04 for the current reporting period; (iii) LF04 remedial performance evaluation; and (iv) conclusions and recommendations.

3.1 SWMU 4/LF04 OVERVIEW

3.1.1 Background

LF04 is located centrally within the Base boundaries, as shown on Figure 2-2. The site layout for LF04 is shown on Figure 3-1A. LF04 is a 45-acre landfill that was operated from 1965 to 1978 for the disposal of general refuse and industrial wastes. WP14 is a 1.5-acre unlined lagoon used from 1962 to 1978 for the disposal of industrial waste treatment plant (IWTP) sludge (including electroplating sludge) and other miscellaneous industrial wastes, such as solvents and oils. WP14 was closed in 1978 by capping with a clayey sand cover approximately 5 ft thick.

In 1982, Robins AFB conducted a basewide survey to identify and assess past hazardous waste disposal practices. LF04 and WP14 were identified as comprising an area with high potential for groundwater contamination and, as a result, were placed on the NPL under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1987.

Site investigations at LF04, WP14, and the adjacent wetlands began in 1980 (Law Engineering and Testing Company, 1980). In 1989, Robins AFB entered into a Federal Facilities Agreement (FFA) with the GA EPD and the US EPA to establish procedures for developing, implementing, and monitoring appropriate response actions in accordance with CERCLA, the National Contingency Plan (NCP), and the Georgia Waste Management Act.

While Remedial Investigation (RI) activities were ongoing in the early 1990's, interim RODs (IRODs) were approved in 1991 for OU1 and in 1995 for OU3. Based on the findings of the RI activities, and in accordance with the IRODs, Robins AFB began implementing the following interim measures (IMs).

- In 1996, Robins AFB remediated WP14 by first treating the waste mass using in-situ volatilization, followed by excavation and solidification (note that the solidified sludge was placed on top of LF04 and covered).
- In 1997, six groundwater recovery wells (RW1 through RW6) were installed along the northeastern corner of LF04, and four leachate pump stations (LF4PS1 through LF4PS4), also referred to as toe drains, were installed around the eastern half of LF04 (Figure 3-1A).

- In 1998, a landfill cover system consisting of a geocomposite liner and a passive landfill gas venting system was constructed. Additionally, a run-on diversion structure was installed next to LF04.

A Feasibility Study (FS) was finalized in 1999 in support of the Final ROD. The Final ROD was submitted to the US EPA in 2000 and was approved in 2004 (Earth Tech, 2004b). A list of COCs and their respective MCLs/RLs, as presented in the 2004 Final ROD, are summarized in Table 3-1. Monitoring and recovery wells installed as part of RI and IM activities and used during this reporting period to monitor the performance of the groundwater recovery system are shown on Figure 3-1B.

3.1.2 Site Hydrogeology and Conceptual Model

The cross-section depicted on Figure 3-2 illustrates a hydrogeologic model for LF04. The following hydrogeologic units are present in the LF04 area:

- surficial aquifer;
- Quaternary alluvial aquifer;
- upper Providence aquifer;
- lower Providence aquifer;
- Cusseta aquitard; and
- Blufftown aquifer (not shown on Figure 3-2).

These hydrogeologic units are consistent with those found elsewhere across the Base. A more detailed discussion of them is presented in Section 2 (GWTS). Groundwater flow in these units is generally to the east toward the Ocmulgee River floodplain.

The refuse or fill material that comprises LF04 forms a distinct perched surficial aquifer that forms a direct hydraulic connection, both laterally and vertically, with the underlying aquifers. The extent of the surficial aquifer is primarily restricted to within the landfill. The groundwater table within the surficial aquifer generally occurs at or near the ground surface to approximately 5 ft bgs, and the groundwater discharges to the wetlands east of the landfill before reaching the Ocmulgee River floodplain.

The Quaternary alluvial aquifer consists of peat, clay, sand, and gravel layers that overlie the upper Providence aquifer. It extends from the western boundary of LF04 to the Ocmulgee River floodplain to the east. Below the landfill, there is a downward vertical gradient from the alluvial aquifer into the upper Providence aquifer. East of the landfill, there is an upward vertical gradient and groundwater discharges into the adjacent wetlands and/or the Ocmulgee River floodplain. The majority of the groundwater contamination associated with LF04 is present within the alluvial aquifer and, for this reason, the groundwater recovery wells are screened in this aquifer.

The upper Providence aquifer consists of fine to coarse-grained sand with interlayered silt and clay, and it extends continuously under the site. Groundwater contamination present within the upper Providence aquifer at LF04 has been shown to be associated with OT37, as discussed in Subsections 3.2 (SWMU 4/LF04 Operational Data) and 3.3 (SWMU 4/LF04 Remedial Performance Evaluation) and Section 7 (SWMU 62/OT37).

3.1.3 ROD Summary and Remedial System Description

The Final ROD for LF04 was signed by the US EPA in September 2004. As stated in the 2004 Final ROD, the remedial action objective (RAO) for OU1 is containment and exposure control. The RAOs for OU3 are: (i) achieve containment and exposure control; (ii) prevent potential impact to adjacent wetlands; and (iii) restore groundwater to MCLs.

The remedy instituted to meet the ROD objectives consists of the following major components.

- For OU1, containment and exposure controls have been in place since the completion of interim measures in 1998. The interim measures included source area treatment, the landfill cover system, passive venting of the landfill gas, and surface water controls.

- For OU3, the groundwater recovery system is comprised of a series of six recovery wells (RW1 through RW6) and four leachate pump stations (LF4PS1 through LF4PS4) installed in 1997. In February 2007, the groundwater recovery system was shut down, with regulatory approval, to allow for the completion of an MNA study. A chronological summary of the individual system component shutdowns includes: (i) RW1 (February 1999) [RW1 was temporarily reactivated from 24 February to 1 June 2005 and from 12 January to 6 September 2006]; (ii) LF4PS3 (March 1999); (iii) RW2, RW3, RW6, LF4PS1, LF4PS2, and LF4PS4 (May 2002); and (iv) RW4 and RW5 (February 2007). In 2010, the US EPA and the GA EPD approved the transition of the site remedy to MNA.
- When the system is operational, groundwater collected from the recovery wells is pumped to the GWTP.
- Continual inspection and maintenance activities and institutional controls/land use controls (LUCs) have been implemented to restrict access to the site (land and groundwater) and future land use.

The 2004 Final ROD also states that continual optimization of the current groundwater recovery system should be performed by evaluating the system's efficiency and effectiveness. Based on this evaluation, the ROD states that, with proper technical evidence, the decision to modify the site remediation approach from an active groundwater recovery system to a more cost effective natural attenuation remedy can be made. As required by the 2004 Final ROD, the second five-year review was completed in July 2006 (Geosyntec, 2006b).

As discussed in the December 2005 to November 2006 Annual Progress Report and in the Second Five-Year Review Report, the groundwater recovery system reached a point of diminishing returns, and from a cost-benefit perspective, it was no longer efficient to continue operation of the system. Consequently, recommendations were made to discontinue pumping from the groundwater recovery system and to transition the remedial approach to MNA. The US EPA (in a 27 January 2007 letter from Dann Spariosu of the US EPA to Becky McCoy of Robins AFB) and the GA EPD (in a 26 October 2006 letter from Bruce Khaleghi of the GA EPD to Kevin Long of Robins AFB) approved the shutdown of the groundwater recovery system, and the system was shut down on 1 February 2007. In addition, the US EPA requested implementation of a study to evaluate the suitability of MNA as an alternative remedial approach for this site, which the Base initiated during the December 2006 to November 2007 reporting period.

Based on a review of the data collected during the MNA study and the site remedial progress following the shutdown of the groundwater recovery system, the US EPA (in a 26 May 2010 letter from Hugh Hazen of the US EPA to Fred Otto of Robins AFB) and the GA EPD (in a 6 July 2010 letter from Amy Potter of the GA EPD to Mark Summers of Robins AFB) approved the transition of the site remedy to MNA. The recovery wells are operated periodically to maintain them in an operational condition in the event that they need to be reactivated.

During the 2010 annual basewide sampling event, the LF04 monitoring and recovery well network included the following:

- nine monitoring wells screened in the surficial aquifer;
- 20 monitoring wells screened in the alluvial aquifer, including one well in the peat/clay layer and the recovery wells;
- 11 monitoring wells screened in the upper Providence aquifer;
- two monitoring wells screened in the lower Providence aquifer;
- one monitoring well screened in the Cusseta aquitard (only a water level was collected at this well; the well was not sampled); and

- seven monitoring wells screened in the Blufftown aquifer (water levels were collected at each of these well, but only two of them were sampled, in accordance with regulatory requirements).

As discussed in the December 2004 to November 2005 Annual Progress Report, the contamination in the upper Providence aquifer detected below LF04 originated from OT37, which is located upgradient of LF04 to the west. Therefore, as approved in the 26 October 2006 letter from Bruce Khaleghi of the GA EPD to Kevin Long of Robins AFB, discussions related to the upper Providence groundwater contaminant plume in this area are presented in Section 7 (SWMU 62/OT37). It should be kept in mind that some of the upper Providence wells are designated as LF04 wells; and therefore, for completeness, analytical data collected from these locations are presented in the data tables in this section as well as Section 7 (SWMU 62/OT37).

3.2 SWMU 4/LF04 OPERATIONAL DATA

As discussed above, during this reporting period the groundwater recovery system at LF04 was not in operation, with regulatory approval, to allow the Base to complete an MNA evaluation for the site. In May and July 2010, the Base received approval from the US EPA and the GA EPD, respectively, to transition the site remedy to MNA. Robins AFB continues to maintain the groundwater recovery system in an operable condition as a contingency measure. For informational purposes, a summary of historic annual flow data for each recovery well is presented in Table 3-2. Yearly average flow rates are calculated based on the operational period of the well. The calculation does not account for periods of temporary downtimes.

The monitoring program during this reporting period included: (i) groundwater level measurements to evaluate groundwater flow direction; (ii) groundwater sampling for site COCs to evaluate remedial progress; and (iii) groundwater sampling for geochemical parameters at select well locations to evaluate whether or not biotic natural attenuation processes are occurring at the site. A summary of these data are presented below, and a detailed evaluation of the results is presented in Subsection 3.3 (SWMU 4/LF04 Remedial Performance Evaluation).

3.2.1 Groundwater Level Measurements

Groundwater levels at LF04 were measured on 13 and 16 April 2010, during the annual basewide sampling event. Water level measurements were collected from a total of 50 monitoring wells during this reporting period. The locations of the wells are shown on Figure 3-1B. Well construction information and water level measurement data are presented in Table 3-3. Groundwater flow direction is discussed in 3.3.1.

3.2.2 Groundwater Sampling

The LF04 wells were sampled once during this reporting period as part of the annual basewide sampling event in April 2010. Samples were analyzed for VOCs. Additionally, select locations were sampled for analysis of inorganics and geochemical parameters. The locations of the groundwater wells sampled during this reporting period are shown on Figure 3-1B.

Table 3-4 presents a statistical summary of the analytes detected in groundwater during this reporting period at LF04, and Table 3-5 summarizes the analytical results. For ease of presentation and subsequent evaluation, the following discussion of results for the LF04 COCs is grouped by hydrogeologic unit.

- In the surficial aquifer, two VOCs (i.e., benzene and chlorobenzene) and two inorganics (i.e., arsenic and thallium) were detected at or above their respective MCLs. Benzene exceeded the MCL of 5 micrograms per liter (µg/L) at five of the nine sampled surficial aquifer wells at concentrations ranging from 6.5 µg/L to 49 µg/L. Chlorobenzene concentrations were at or exceeded the MCL of 100 µg/L at three of the nine sampled surficial aquifer wells at concentrations ranging from 100 µg/L and 380 µg/L. Arsenic exceeded the MCL of 10 µg/L at five of the nine sampled surficial aquifer wells at concentrations ranging from 16.3 µg/L to 139 µg/L. Thallium was detected at low concentrations as estimated values (i.e., the results were between the method detection limit and the laboratory reporting limit).

- In the Quaternary alluvial aquifer, eight VOCs (1,4-dichlorobenzene, benzene, carbon tetrachloride, chlorobenzene, cis-DCE, PCE, TCE, and vinyl chloride) were detected at or above their respective MCLs. TCE is the most prevalent COC detected in the alluvial aquifer. TCE concentrations in samples collected during the current reporting period exceeded the MCL of 5 µg/L at eight of the 20 locations sampled. The highest TCE concentrations were generally found along the northeastern perimeter of LF04, which is the downgradient side of the landfill. The maximum TCE concentration detected in the alluvial aquifer was 36 µg/L, at LF4WP7. The remaining VOCs, detected at concentrations above the MCLs, were generally near the former WP14 (i.e., LF4-6 and LF4WP1) source area.
- In the upper Providence aquifer, the TCE concentrations, along with the other detected VOCs, are associated with releases from OT37. Therefore, discussions related to the upper Providence groundwater contaminant plume in the LF04/OT37 area are presented in Section 7 (SWMU 62/OT37).
- In the lower Providence and Blufftown aquifers, no contaminants were detected above the MCLs.

3.3 SWMU 4/LF04 REMEDIAL PERFORMANCE EVALUATION

This subsection presents a detailed review of the data presented in Subsection 3.2 (SWMU 4/LF04 Operational Data). The data are evaluated against the following ROD objectives summarized earlier (in 3.1.3): (i) achieve containment and exposure control; (ii) prevent potential impact to adjacent wetlands; and (iii) restore groundwater to MCLs. These evaluations are presented to monitor the remedial progress at LF04.

3.3.1 Evaluation of Groundwater Flow

As reported in 3.2.1, groundwater level measurements were collected from 50 monitoring wells in the LF04 area and the data were used to generate the potentiometric maps presented on Figures 3-3 through 3-6, for the surficial, Quaternary alluvial, upper Providence, and lower Providence aquifers, respectively. These data were supplemented with water level data from monitoring wells located in surrounding areas. The information in Table 3-3 includes data from LF04 only, and the table does not include all data used to construct the potentiometric maps. As shown on these figures, groundwater flow is generally to the east and northeast toward the wetlands and the Ocmulgee River floodplain.

As shown on Figure 3-3, groundwater in the surficial aquifer flows in a radial pattern and discharges into the surrounding wetlands and/or upper Providence aquifers. There is a downward vertical hydraulic gradient across the entire surficial aquifer at LF04 into the underlying alluvial aquifer.

Based on a review of the potentiometric data points for the alluvial and upper and lower Providence aquifers, as shown on Figures 3-4 through 3-6, the vertical component of the hydraulic gradient reverses direction as groundwater flows from west to east. The vertical hydraulic gradient has a slight downward direction to the west of LF04 and transitions into an upward vertical gradient toward the center of the landfill, which progressively increases in the wetland area east of the landfill. There may be, however, localized exceptions to these conditions (i.e., reversal or amplification of the natural gradient).

3.3.2 Evaluation of Remedial Progress

As part of the annual progress reporting and ongoing remedial process optimization efforts, current and historical site data are used to evaluate remedial progress at LF04. To facilitate these efforts, a review of contaminant concentrations, isoconcentration maps, and time trend analyses is conducted. During this reporting period, the groundwater recovery system was not in operation. However, for completeness, mass removal estimates from previous reporting periods are presented in Tables 3-6 and 3-7. Additionally, historical contaminant-specific mass removal estimates for each recovery well are presented in Appendix D1.

TCE has historically been identified as the primary COC for LF04 groundwater contamination and, therefore, was selected as the indicator parameter for the LF04 remedial performance evaluation. During this reporting period, TCE was not detected at concentrations exceeding the MCLs in the surficial aquifer and lower Providence aquifer, and, for this reason, TCE plume maps have not been prepared for these aquifers. As discussed previously, a TCE plume map for the upper Providence aquifer is presented in Section 7 (SWMU 62/OT37).

The current TCE plume configuration in the alluvial aquifer is depicted on Figure 3-7 and is presented in historic context on Figure 3-8. Additionally, statistical trend analyses of TCE concentrations of individual wells were conducted to better understand the plume conditions and to evaluate the remedial progress during the MNA study period. The nonparametric Mann-Kendall test method described in Appendix C1 was used in statistical trend analyses of the available data. The results of the statistical trend analyses and the full-size graphical presentation of TCE concentration time trends are provided in Appendix C2. To assist in the evaluation of the overall remedial progress, the groundwater concentration time trends for the other prominent COCs (i.e., benzene and chlorobenzene) are also presented on the figures in Appendix C2. To evaluate concentration trends on a sitewide basis, smaller scale time trend charts with benzene, chlorobenzene, and TCE concentrations for a number of wells are posted on the TCE plume map presented on Figures 3-9A and 3-9B for the alluvial aquifer. The following discussions provide more details about the current contaminant distribution and the remedial progress for both the surficial and alluvial aquifers.

- *Surficial Aquifer* – In 1998, the maximum concentrations of TCE and cis-DCE, a degradation daughter product of TCE, were 590 μg/L and 1,300 μg/L, respectively.

As a result of effective remediation and natural attenuation, the concentrations of TCE and its daughter products have generally been reduced to levels below their respective MCLs and are no longer COCs in the surficial aquifer. Currently, as discussed in 3.2.2, among the remaining contaminants, benzene is the most widely distributed contaminant, with detections above the MCL at five of the nine wells sampled during the current reporting period. The highest concentrations of benzene are detected at the center of the landfill, with concentrations decreasing to non-detect along the eastern boundary (i.e., the plume is stable and not migrating). A limited number of other contaminants (i.e., chlorobenzene, arsenic, and thallium) are still present at generally low concentrations in the surficial aquifer. The detections of these contaminants are generally consistent with historic data and isolated to locations within the landfill. Additionally, groundwater data from the site generally indicate that the underlying alluvial aquifer and areas outside the landfill are not impacted by benzene, chlorobenzene, arsenic, or thallium.

- *Alluvial Aquifer* – Historically, as shown on Figures 3-7 and 3-8, TCE concentrations have decreased significantly. The maximum TCE concentration of 2,800 μg/L in 1997 has decreased to a maximum of 36 μg/L in April 2010. Also evident is a significant reduction in the lateral extent of the contaminant plume, which is currently only approximately one-quarter of its 1997 size. As presented on Figures 3-7 and 3-8, the leading edge of the groundwater contaminant plume has not migrated since the groundwater recovery system was shut down. TCE concentrations in groundwater samples collected from monitoring wells located downgradient and on the fringes of the plume decreased from the concentrations reported in the previous Annual Progress Report [e.g., on the fringes of the plume, TCE concentrations have decreased from 15 μg/L to non-detect below the MCL at LF4WP10; from 30 μg/L to 14 μg/L at LF4WP11; and from 6.8 μg/L to 3.9 J (estimated) μg/L at LF4WP12]. Additionally, TCE concentrations at RW4 and LF4WP7, located in the core of the plume, decreased from 26 µg/L to 20 µg/L and 60 µg/L to 36 µg/L, respectively. As shown on the time trends on Figure 3-9A, concentrations of benzene and chlorobenzene remain above their respective MCLs at LF4-6 and LF4WP1. LF4-6 is located within the landfill in the immediate vicinity of the former waste pit. Groundwater collected from this location exhibits the highest benzene (200 µg/L) and chlorobenzene (2,100 µg/L) concentrations at the site. LF4WP1 is located within the landfill and approximately 130 ft downgradient of LF4-6 and the former waste pit. Benzene and chlorobenzene concentrations at this location are less than those observed at LF4-6 and show decreasing trends over the past three years. The benzene and chlorobenzene concentrations at LF4WP8, located approximately 170 ft downgradient of LF4WP1 continue to remain below the MCL, with decreasing trends.

Table 3-8 provides a summary of the sampling results obtained for the geochemical parameters and chlorinated ethenes at LF04. Based on these data, the geochemical condition of the alluvial aquifer is generally aerobic, as indicated by dissolved oxygen (DO) levels greater than one milligram per liter (mg/L) and positive oxidation reduction potential (ORP). Additionally, the pH values (i.e., typically less than 6) were outside the range of values in which biodegradation typically occurs.

The only exception to the above observations was the groundwater sample collected from LF4-6, which is located at the northeast corner of WP14. As shown on Figure 3-10, conditions in the groundwater at this location are favorable for reductive dechlorination (i.e., DO is less than one mg/L, ORP is negative, pH is near neutral). Additionally, natural or manmade carbon sources [i.e., total organic carbon (TOC) at 29.2 mg/L] are available to provide energy for microbial activity. Further, the presence of methane, ethane, and ethene are indicative of reductive dechlorination at this location.

Figure 3-11 provides a spatial distribution of chlorinated ethenes within the alluvial aquifer. The absence of PCE and TCE in the 2009 groundwater sample collected from LF4-6, coupled with the detection of degradation products (i.e., cis-DCE, vinyl chloride, and ethene) indicate that reductive dechlorination is occurring in the WP14 area, consistent with the geochemical data presented above. Detections of degradation products were generally limited outside of the WP14 area, indicating that, in these areas, reductive dechlorination is either not occurring or is only occurring to a limited degree.

Since the shutdown of the groundwater recovery system in February 2007, four sets of groundwater data have been collected. Based on these data, there has been no plume migration, and the majority of the wells have continued their decreasing concentration trends. Although slight rebound was observed at a few isolated locations (e.g., RW3, RW4, LF4-27, LF4WP7, LF4WP10), shortly after the recovery system was shut down, the level of rebound was generally limited and well within the anticipated increase in concentrations expected after the shutdown of the groundwater recovery system. Concentrations at each of these locations have since decreased, with most locations continuing the downward trend that was present prior to the shutdown of the groundwater recovery system.

Based on the data collected in 2010, of the 20 monitoring wells screened in the alluvial aquifer at LF04, only eight have TCE concentrations that remain above the MCL (Figure 3-7). TCE concentrations at these eight locations continue to show decreasing trends, seven of which exhibit statistically significant decreasing trends. A review of the time trends indicates that concentrations in these wells will continue to decrease at a rate generally similar to that observed during the two to three year period immediately before the groundwater recovery system was shut down. Based on a forward projection of these decreasing concentration trends, it is anticipated that the TCE concentrations at LF04 will drop below the MCL within approximately the next ten years.

3.4 SWMU 4/LF04 CONCLUSIONS AND RECOMMENDATIONS

This subsection briefly summarizes the major findings during this reporting period and provides recommendations for a strategy for the upcoming reporting period(s). The findings are interpreted in the context of the RAOs for OU3 described in the 2004 Final ROD (i.e., achieve containment and exposure control; prevent potential impact to adjacent wetlands; and restore groundwater to MCLs).

3.4.1 Conclusions

In summary, the following conclusions can be made with respect to conditions at LF04.

- As a result of effective remediation and natural attenuation, primary contaminants (i.e., TCE and cis-DCE) are no longer detected in the surficial aquifer. Of the residual contaminants still present, benzene is the most prevalent. The highest concentrations of benzene are detected at the center of the landfill, with concentrations decreasing to non-detect along the eastern boundary (i.e., the plume is stable and not migrating). A limited number of other contaminants (i.e., chlorobenzene, arsenic, and thallium) are still present at generally low concentrations in the surficial aquifer. The detections of these contaminants are generally consistent with historic data and isolated to locations within the landfill. Groundwater data from the site generally indicate that the underlying alluvial aquifer and areas outside the landfill are not impacted by these contaminants.
- TCE concentrations in the alluvial aquifer have decreased significantly since 1997, when the maximum TCE concentration was 2,800 µg/L, to a maximum concentration of 36 µg/L in 2010. The lateral extent of the contaminant plume has been reduced to approximately one-quarter of its 1997 size. Concentrations on the leading edge of the plume decreased from the previous reporting period. There has been no plume

migration, and the majority of the wells have continued their decreasing concentration trends.

- Concentrations of benzene and chlorobenzene remain above their respective MCLs at LF4-6 and LF4WP1. LF4-6 is located within the landfill in the immediate vicinity of the former waste pit. Groundwater collected from this location exhibits the highest benzene and chlorobenzene concentrations at the site. LF4WP1 is located within the landfill and downgradient of LF4-6. Benzene and chlorobenzene concentrations at this location are less than those observed at LF4-6 and show decreasing trends over the past three years. The benzene and chlorobenzene concentrations at LF4WP8, located downgradient of LF4WP1 continue to remain below the MCL, with decreasing trends.
- Based on the data collected as part of the MNA study, with the exception of the area in the vicinity of LF4-6, reductive dechlorination is either not occurring or is only occurring to a limited degree at LF04. Abiotic attenuation appears to be the predominant natural attenuation mechanism responsible for contaminant reductions observed in the majority of the wells at LF04. Slight rebound observed at a few isolated locations during the previous three reporting periods was limited and well within the anticipated increase in concentrations expected after the shutdown of the groundwater recovery system. Concentrations at many of these locations have since decreased, with concentrations at most locations continuing the downward trend that was present prior to the shutdown of the groundwater recovery system.

3.4.2 Recommendations

In consideration of the data, evaluations, and overall synthesis of information contained herein, the transition of the site remedy to MNA was appropriate. The time frame to achieve the remedial objectives with an MNA approach is reasonable when compared to operation of the groundwater recovery system and is anticipated to be on the order of approximately ten years. Operation of the groundwater recovery system will not provide any additional benefit over an MNA approach. As a result, no process modifications are anticipated during the upcoming year.

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TABLES

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Table No. 3-1
Contaminants of Concern for LF04 OU3 (Groundwater)

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

Chemical		MCL/RL [1] (µg/L)	Aquifer		
			Surficial	Quaternary	Upper Providence
VOCs	Benzene	5	X		
	Carbon Tetrachloride	5		X	X
	Chlorobenzene	100	X	X	
	Cis-1,2-dichloroethene	70	X		
	Tetrachloroethene	5	X	X	X
	Trichloroethene	5	X	X	X
	Vinyl chloride	2		X	
Metals	Arsenic	10	X		
	Cadmium	5	X		
	Chromium	100	X		
	Lead	15 [2]	X		

Notes:

MCL - Maximum Contaminant Level.

RL - Remedial Level.

-- µg/L - micrograms per liter.

[1] If not otherwise specified, RLs are equal to MCLs for Drinking Water (2009 Edition of the Drinking Water Standards and Health Advisories).

[2] MCL is the tap action level.

Table No. 3-2
Historical Annual Average Flow Rates for LF04 RW Series Wells

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

Reporting Period	RW1[2]			RW2[3]			RW3[3]			RW4[4]			RW5[4]			RW6[3]		
	Total Flow	Average Flow[1]		Total Flow	Average Flow[1]		Total Flow	Average Flow[1]		Total Flow	Average Flow[1]		Total Flow	Average Flow[1]		Total Flow	Average Flow[1]	
	(gal)	(gpd)	(gpm)	(gal)	(gpd)	(gpm)	(gal)	(gpd)	(gpm)	(gal)	(gpd)	(gpm)	(gal)	(gpd)	(gpm)	(gal)	(gpd)	(gpm)
December 2009 - November 2010[6]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
December 2008 - November 2009	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
December 2007 - November 2008	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
December 2006 - November 2007	--	--	--	--	--	--	--	--	--	4,320,973	68,587	47.6	2,985,362	47,387	32.9	--	--	--
December 2005 - November 2006	8,269,204	34,745	24.1	--	--	--	--	--	--	25,746,096	70,537	49.0	15,665,421	42,919	29.8	--	--	--
December 2004 - November 2005	3,842,203	39,206	27.2	--	--	--	--	--	--	24,173,115	66,228	46.0	20,592,768	56,419	39.2	--	--	--
December 2003 - November 2004	--	--	--	--	--	--	--	--	--	27,433,472	74,955	52.1	18,670,862	51,013	35.4	--	--	--
December 2002 - November 2003	--	--	--	--	--	--	--	--	--	27,822,552	76,226	52.9	24,418,905	66,901	46.5	--	--	--
December 2001 - November 2002	--	--	--	4,432,142	26,700	18.5	5,781,913	34,831	24.2	15,900,186	43,562	30.3	18,555,348	50,837	35.3	5,733,209	34,537	24.0
December 2000 - November 2001	--	--	--	9,175,057	25,137	17.5	13,239,577	36,273	25.2	14,119,760	38,684	26.9	11,132,467	30,500	21.2	12,960,375	35,508	24.7
December 1999 - November 2000	--	--	--	9,640,637	26,341	18.3	13,402,874	36,620	25.4	13,686,912	37,396	26.0	12,087,731	33,027	22.9	12,447,138	34,009	23.6
December 1998 - November 1999	1,671,814	22,902	15.9	9,332,193	25,568	17.8	15,415,229	42,234	29.3	18,330,058	50,219	34.9	13,881,084	38,030	26.4	14,213,970	38,942	27.0
October 1997 - November 1998	8,991,794	21,107	14.7	9,109,819	21,385	14.9	16,918,510	39,715	27.6	16,874,663	39,612	27.5	12,225,317	28,698	19.9	12,561,854	29,488	20.5

Reporting Period	All Wells		
	Total Flow	Average Flow[1]	
	(gal)	(gpd)	(gpm)
December 2009 - November 2010[6]	--	--	--
December 2008 - November 2009	--	--	--
December 2007 - November 2008	--	--	--
December 2006 - November 2007	7,306,335	115,974	80.5
December 2005 - November 2006	49,680,720	136,112	94.5
December 2004 - November 2005	48,608,086	133,173	92.5
December 2003 - November 2004	46,104,333	125,968	87.5
December 2002 - November 2003	52,241,457	143,127	99.4
December 2001 - November 2002	50,402,798	138,090	95.9
December 2000 - November 2001	60,627,236	166,102	115.3
December 1999 - November 2000	61,265,292	167,392	116.2
December 1998 - November 1999	72,844,348	199,574	138.6
October 1997 - November 1998	76,681,957	180,005	125.0

Notes:
gal - gallons.
gpd - gallons per day.
gpm - gallons per minute.
-- Pump not operational in the given period of time.
(1) Yearly average flow rates in gpd and gpm are calculated based on the operational period of the well. However, the calculation does not account for periods of temporary downtime.
(2) RW1 began operating in October 1997 and was shut down, with regulatory approval, on 11 February 1999. RW1 was temporarily reactivated from 24 February 2005 to 1 June 2005 and from 12 January 2006 to 6 September 2006.
(3) RW2, RW3, and RW6 began operating in October 1997 and were shut down, with regulatory approval, on 14 May 2002.
(4) RW4 and RW5 began operating in October 1997 and were shut down, with regulatory approval, on 1 February 2007.
(5) The toe drain pumps began operating in October 1997 and were shut down, with regulatory approval, on 17 March 1999 (LF4PS3) and 14 May 2002 (LF4PS1, LF4PS2, and LF4PS4). The flow data are not presented.
(6) In 2010, the GA EPD and the US EPA approved transition of the site remedy to MNA.

Table No. 3-3
LF04 Well Construction Details and Groundwater Elevation Data

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

Well ID	Northing (ft)	Easting (ft)	Ground Surface Elevation (ft above MSL)	TOC Elevation (ft above MSL)	Total Depth of Well (ft BGS)	Well Bottom Elevation (ft above MSL)	Hydrogeologic Unit	Screen Interval (ft BGS)	Screen Interval (ft above MSL)	DTW (ft BTOC)	Water Level Elev. (ft above MSL)	Notes
LF4-6	953853.60	2476795.53	253.80	255.89	25.0	228.80	QUAT	15.0 - 25.0	238.8 - 228.8	5.36	250.53	(1)
LF4-11	953080.72	2477755.53	250.74	254.75	65.0	185.74	UPROV	50.0 - 65.0	200.7 - 185.7	5.82	248.93	(1)
LF4-17	953511.48	2478888.12	248.90	250.62	23.0	225.90	QUAT	13.0 - 23.0	235.9 - 225.9	5.72	244.90	(1)
LF4-18	953918.78	2478832.02	248.50	250.20	18.0	230.50	QUAT	8.0 - 18.0	240.5 - 230.5	5.12	245.08	(1)
LF4-19	953242.88	2479013.51	249.00	248.67	25.0	224.00	QUAT	15.0 - 25.0	234.0 - 224.0	3.50	245.17	(1)
LF4-20	953756.98	2476835.40	253.10	256.40	8.0	245.10	SURF	3.0 - 8.0	250.1 - 245.1	5.08	251.32	(1)
LF4-23	953671.81	2476953.29	255.08	259.04	27.5	227.58	QUAT	17.5 - 27.5	237.6 - 227.6	8.17	250.87	(1)
LF4-27	953399.69	2477511.62	253.40	261.94	31.0	222.40	QUAT	21.0 - 31.0	232.4 - 222.4	12.54	249.40	(1)
LF4-28	953321.79	2477685.02	251.20	256.73	8.0	243.20	SURF	3.0 - 8.0	248.2 - 243.2	6.27	250.46	(1)
LF4-29	953066.75	2477743.47	251.25	255.41	8.0	243.25	SURF	3.0 - 8.0	248.3 - 243.3	4.35	251.06	(1)
LF4-30	952593.61	2477324.92	253.96	256.37	28.5	225.46	QUAT	18.5 - 28.5	235.5 - 225.5	5.84	250.53	(1)
LF4-42	953567.15	2477139.90	254.57	258.80	57.0	197.57	UPROV	47.0 - 57.0	207.6 - 197.6	8.98	249.82	(1)
LF4-44	953854.90	2476790.23	253.80	255.34	8.5	245.30	SURF	3.5 - 8.5	250.3 - 262.3	4.37	250.97	(1)
LF4-46	952750.48	2476575.39	262.35	267.22	26.0	236.35	UPROV	21.0 - 26.0	241.4 - 236.4	14.95	252.27	(1)
LF4-47	953292.47	2476725.87	259.68	267.37	27.5	232.18	UPROV	22.5 - 27.5	237.2 - 232.2	16.03	251.34	(1)
LF4-48	953280.05	2476117.26	263.55	271.11	25.0	238.55	UPROV	20.0 - 25.0	243.6 - 238.6	16.28	254.83	(1)
LF4BL1	952701.62	2474944.44	299.45	302.23	217.0	82.45	BLUFF	207.0 - 217.0	92.5 - 82.5	44.31	257.92	(1)
LF4BL2	952217.41	2475826.73	290.73	293.48	216.0	74.73	BLUFF	206.0 - 216.0	84.7 - 74.7	37.20	256.28	(1)
LF4BL3	952568.09	2477314.36	253.46	257.88	181.0	72.46	BLUFF	171.0 - 181.0	82.5 - 72.5	4.38	253.50	(1)
LF4BL4CU	952990.40	2477707.09	256.23	258.92	160.0	96.23	CUSSETA	150.0 - 160.0	106.2 - 96.2	8.82	250.10	(1)
LF4BL5	953593.55	2477093.08	254.95	258.76	176.0	78.95	BLUFF	166.0 - 176.0	89.0 - 79.0	5.16	253.60	(1)
LF4BL6	953902.27	2476684.14	254.24	256.04	150.0	104.24	BLUFF	140.0 - 150.0	114.2 - 104.2	2.20	253.84	(1)
LF4BL7	952794.21	2479148.06	248.23	252.73	182.0	66.23	BLUFF	172.0 - 182.0	76.2 - 66.2	1.76	250.97	(1)
LF4BL8	953935.17	2478776.25	250.10	252.11	178.0	72.10	BLUFF	168.0 - 178.0	82.1 - 72.1	0.50	251.61	(1)
LF4PR1	952689.82	2474930.94	299.53	301.98	140.0	159.53	LPROV	130.0 - 140.0	169.5 - 159.5	43.18	258.80	(1)
LF4PR2	952201.81	2475828.43	290.94	293.45	135.0	155.94	LPROV	125.0 - 135.0	165.9 - 155.9	37.59	255.86	(1)
LF4PR3	952701.72	2474931.24	299.37	301.72	70.0	229.37	UPROV	60.0 - 70.0	239.4 - 229.4	42.60	259.12	(1)
LF4PR4	952197.91	2475817.83	291.69	294.41	70.0	221.69	UPROV	60.0 - 70.0	231.7 - 221.7	37.87	256.54	(1)
LF4WP1	953840.70	2476928.53	248.80	252.22	7.1	241.70	PC	4.6 - 7.1	244.2 - 241.7	2.76	249.46	(1)
LF4WP7	953422.80	2477883.23	247.80	249.35	13.6	234.20	QUAT	11.1 - 13.6	236.7 - 234.2	1.21	248.14	(1)
LF4WP8	953874.70	2477093.53	250.50	250.83	17.2	233.30	QUAT	12.2 - 17.2	238.3 - 233.3	1.41	249.42	(1)
LF4WP9	953647.70	2477413.53	247.90	248.86	14.1	233.80	QUAT	9.1 - 14.1	238.8 - 233.8	0.00	248.86	(1)
LF4WP10	953560.05	2478031.36	247.10	250.28	16.7	230.40	QUAT	11.7 - 16.7	235.4 - 230.4	2.45	247.83	(1)
LF4WP11	953294.69	2478056.52	247.50	248.46	16.4	231.10	QUAT	11.4 - 16.4	236.1 - 231.1	0.86	247.60	(1)
LF4WP12	952894.69	2477985.52	247.50	250.53	17.0	230.50	QUAT	12.0 - 17.0	235.5 - 230.5	2.17	248.36	(1)
LSB5	953717.51	2476354.13	259.82	263.66	16.0	243.82	SURF	6.0 - 16.0	253.8 - 243.8	9.43	254.23	(1)
LSB11	953200.71	2476262.33	263.78	271.19	16.5	247.28	SURF	6.5 - 16.5	257.3 - 247.3	12.12	259.07	(1)
LSB13	953134.62	2476565.92	265.80	268.44	17.0	248.80	SURF	7.0 - 17.0	258.8 - 248.8	16.18	252.26	(1)
LSB14	952841.19	2477419.52	258.69	263.23	17.0	241.69	SURF	7.0 - 17.0	251.7 - 241.7	10.14	253.09	(1)
LSB15	953250.99	2477476.12	256.76	262.56	17.0	239.76	SURF	7.0 - 17.0	249.8 - 239.8	10.09	252.47	(1)
RI1-2W	952961.91	2475895.43	273.30	275.14	50.0	223.30	UPROV	40.0 - 50.0	233.3 - 223.3	19.84	255.30	(1)
RI1-4W	952610.31	2476044.63	276.00	278.27	50.0	226.00	UPROV	40.0 - 50.0	236.0 - 226.0	22.89	255.38	(1)
RI1-6W	953055.31	2475985.63	265.40	265.88	24.1	241.32	UPROV	14.1 - 23.7	251.3 - 241.7	10.82	255.06	(1)
RI1-7W	952868.61	2476146.13	269.60	273.24	36.2	233.43	UPROV	26.2 - 35.8	243.4 - 233.8	18.34	254.90	(1)
RW1	953882.21	2476679.53	253.80	255.95	37.5	216.3	QUAT	22.5 - 32.5	231.3 - 221.3	5.10	250.85	(1)
RW2	953738.90	2476844.42	254.02	256.44	34.9	219.17	QUAT	19.8 - 29.8	234.2 - 224.2	5.69	250.75	(1)
RW3	953078.56	2477746.91	251.62	255.34	27.8	223.82	QUAT	17.8 - 22.8	233.8 - 228.8	6.27	249.07	(1)
RW4	953327.61	2477672.89	254.34	256.85	32.5	221.84	QUAT	22.5 - 27.5	231.8 - 226.8	7.49	249.36	(1)
RW5	953669.77	2477104.33	251.97	255.87	28.0	223.97	QUAT	16.0 - 26.0	236.0 - 226.0	5.77	250.10	(1)
RW6	953564.13	2477274.89	253.02	256.13	32.0	221.02	QUAT	20.0 - 30.0	233.0 - 223.0	7.33	248.80	(1)

Notes:

"TOC" - Top of Casing.
"DTW" - Depth to Water.
"ft above MSL" - Feet Above Mean Sea Level.
"ft BGS" - Feet Below Ground Surface.

"ft BTOC" - Feet Below Top of Casing.
"SURF" - Surficial.
"PC" - Peat/Clay.
"QUAT" - Quaternary Alluvium.

"UPROV" - Upper Providence.
"LPROV" - Lower Providence.
"CUSSETA" - Cusseta.
"BLUFF" - Blufftown.

(1) Water level measurements were obtained from 13 to 16 April 2010.

Table No. 3-4
Summary Statistics for LF04 Groundwater Monitoring (2010)

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

Parameter	RL/MCL[1]	Total Locations Sampled[5]	Locations Detected	Locations over RL/MCL	Maximum Detection	Location of Maximum Detection	Aquifer/Unit of Maximum Detection
Volatile Organics (µg/L)							
1,2-dichlorobenzene	600	44	4	0	490	LF4-6	QUAT
1,2-dichloroethane	5	44	1	0	0.92	LF4-46	UPROV
1,3-dichlorobenzene		44	4	-	21 J	LF4-6	QUAT
1,4-dichlorobenzene	75	44	11	1	[illegible]	LF4-6	QUAT
2-butanone (MEK)		44	1	-	4.2 J	LSB5	SURF
acetone		44	1	-	9.0	RI1-4W	UPROV
benzene	5	44	11	8	290	LF4-6	QUAT
carbon tetrachloride	5	44	18	3	[illegible]	LF4-47	UPROV
chlorobenzene	100	44	17	5	[illegible]	LF4-6	QUAT
chloroethane		44	1	-	3.7	LF4-29	SURF
chloroform	80[3]	44	1	0	4.6	LF4-30	QUAT
cis-1,2-dichloroethene	70	44	18	1	[illegible]	LF4-6	QUAT
cyclohexane		43	1	-	1.4	LF4-44	SURF
dichloromethane (methylene chloride)	5	44	2	1	9.0 J	LF4BL1	BLUFF
ethylbenzene	700	44	3	0	14.0	LF4-6	QUAT
isopropylbenzene		44	7	-	3.1	LSB14	SURF
methylcyclohexane		43	4	-	6.0	LF4-6	QUAT
tetrachloroethene	5	44	21	7	19.0	RI1-6W	UPROV
toluene	1,000	44	5	0	51.0	LF4-6	QUAT
trans-1,2-dichloroethene	100	44	1	0	0.58	LF4WP9	QUAT
trichloroethene	5	44	22	12	[illegible]	LF4WP7	QUAT
vinyl chloride	2	44	1	1	[illegible]	RW1	QUAT
xylenes	10,000	44	6	0	72.0	LF4-6	QUAT
Inorganics (µg/L)							
aluminum		9	4	-	373	LSB5	SURF
antimony	6	9	1	0	4.9 J	LF4-28	SURF
arsenic	10	9	7	5	[illegible]	LF4-28	SURF
barium	2,000	9	9	0	1,520	LSB11	SURF
cadmium	5	9	5	0	1.6 J	LSB5	SURF
calcium		9	9	-	173,000	LF4-28	SURF
chromium	100	9	9	0	12.3	LSB15	SURF
cobalt		9	5	-	6.1 J	LSB13	SURF
copper	1,300[2]	9	3	0	17.8 J	LSB5	SURF
iron		9	9	-	77,600	LSB11	SURF
lead	15[2]	9	4	0	8.8	LSB14	SURF
magnesium		9	9	-	66,200	LSB13	SURF
manganese		9	9	-	1,410	LSB15	SURF
mercury	2	9	1	0	1.0	LSB13	SURF
nickel		9	9	-	143	LSB5	SURF
potassium		9	9	-	99,200	LSB14	SURF
sodium		9	9	-	255,000	LSB14	SURF
thallium	2	9	9	9	4.8 J	LSB5	SURF
vanadium		9	3	-	25.6 J	LSB13	SURF
zinc		9	6	-	274	LSB15	SURF
Others[4] (mg/L)							
ethane		11	1	-	0.13	LF4-6	QUAT
ethene		11	1	-	0.06	LF4-6	QUAT
methane		11	11	-	13.0	LF4-6	QUAT
TOC		11	4	-	29.2	LF4-6	QUAT

Notes:
"J" - estimated concentration.
-- µg/L - micrograms per liter.
-- mg/L - milligrams per liter.
-- RL - Remedial Level.
-- MCL - Maximum Contaminant Level.
-- Shaded areas indicate concentrations exceeding the RL/MCL.
(1) If not otherwise specified, RLs are equal to MCLs for Drinking Water (2009 Edition of the Drinking Water Standards and Health Advisories).
(2) MCL is the tap action level.
(3) Value based on the MCL of total Trihalomethanes (THMs).
(4) Samples analyzed by Sirem Laboratory in Guelph, Canada for ethane, ethene, and methane and by Gulf Coast Analytical Laboratories in Baton Rouge, Louisiana for TOC in support of the MNA study.
(5) LF4-17 is sampled on a biennial schedule and was not scheduled for sampling in 2010. However, in support of the MNA study, the well was sampled, and the sample was analyzed for volatile organics using method SW8260. This method did not include cyclohexane or methylcyclohexane in the analyte list.
Hydrogeologic units:
SURF - Surficial.
QUAT - Quaternary Alluvium.
UPROV - Upper Providence.
BLUFF - Blufftown.

GA100539
2010.3-4 Summary Statistics.xlsx

Table No. 3-5
Summary of Analytical Results for LF04 Groundwater Monitoring Wells (2010)

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

Location ID		LF4-6	LF4-11	LF4-17(5)	LF4-18	LF4-19	LF4-20	LF4-23	LF4-27	LF4-28	LF4-29	LF4-30	LF4-42	LF4-44	LF4-46	LF4-47	LF4-48	LF4BL1	LF4BL2
Sample Date		4/14/2010	4/15/2010	4/16/2010	4/15/2010	4/15/2010	4/15/2010	4/15/2010	4/14/2010	4/14/2010	4/15/2010	4/14/2010	4/15/2010	4/14/2010	4/14/2010	4/15/2010	4/15/2010	4/16/2010	4/16/2010
Hydrogeologic Unit		QUAT	UPROV	QUAT	QUAT	QUAT	SURF	QUAT	QUAT	SURF	SURF	QUAT	UPROV	SURF	UPROV	UPROV	UPROV	BLUFF	BLUFF
Screen		15 - 25	50 - 65	13 - 23	8 - 18	15 - 25	3 - 8	17.5 - 27.5	21 - 31	3 - 8	3 - 8	18.5 - 28.5	47 - 57	3.5 - 8.5	21 - 26	22.5 - 27.5	20 - 25	207 - 217	206 - 216
Sample Type	RL/MCL(1)	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
Volatile Organics (µg/L)																			
1,2-dichlorobenzene	600	490	0.50 U	0.079 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	3.0	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
1,2-dichloroethane	5	5.0 U	0.50 U	0.086 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.92	0.50 U	0.50 U	5.0 U	0.50 U
1,3-dichlorobenzene		21.0 J	0.50 U	0.099 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.6	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
1,4-dichlorobenzene	75	300	0.50 U	0.12 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.89	1.6	0.50 U	0.50 U	3.1	2.5	0.50 U	0.50 U	5.0 U	0.50 U
2-butanone (MEK)		50.0 UJ	5.0 U	0.093 U	5.0 U	5.0 U	5.0 UJ	5.0 U	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	50.0 U	5.0 U
acetone		50.0 UJ	5.0 U	1.2 U	5.0 U	5.0 U	5.0 UJ	5.0 U	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	50.0 U	5.0 U
benzene	5	1200	0.50 U	0.054 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	2.3	210	0.50 U	1.7	5.0 U	0.50 U
carbon tetrachloride	5	5.0 UJ	0.50 U	0.15 U	0.50 U	0.50 U	0.50 UJ	4.6	1.4	0.50 UJ	0.50 UJ	2.5	0.50 U	0.50 U	0.50 U	21.0	0.50 U	5.0 U	0.50 U
chlorobenzene	100	2,100	0.50 U	0.027 U	0.50 U	0.50 U	1.4	2.4	0.50 U	4.9	12.0	0.50 U	0.50 U	23.0	17.0	0.50 U	2.1	5.0 U	0.50 U
chloroethane		5.0 U	0.50 U	0.35 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	3.7	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
chloroform	80(4)	5.0 U	0.50 U	0.057 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	4.6	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
cis-1,2-dichloroethene	70	180	0.50 U	1.5 J	0.69	0.50 U	0.50 U	6.1	1.9	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.2	1.7	0.50 U	5.0 U	0.50 U
cyclohexane		5.0 U	0.50 U	N/A	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.4	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
dichloromethane (methylene chloride)	5	5.0 U	0.50 U	0.33 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 UJ	0.50 U	9.0 J	0.50 U
ethylbenzene	700	14.0	0.50 U	0.063 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
isopropylbenzene		5.0 U	0.50 U	0.035 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.7	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
methylcyclohexane		6.0	0.50 U	N/A	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	2.4	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
tetrachloroethene	5	5.0 U	0.50 U	0.12 U	1.5	0.97	0.50 U	1.7	8.2	0.50 U	0.50 U	0.69	0.50 U	0.50 U	0.50 U	4.2	0.50 U	5.0 U	0.50 U
toluene	1,000	51.0	0.50 U	0.059 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.51	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
trans-1,2-dichloroethene	100	5.0 U	0.50 U	0.11 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
trichloroethene	5	5.0 U	0.50 U	4.7 J	1.8	2.3	0.50 U	6.2	9.3	0.50 U	0.50 U	2.2	0.50 U	0.50 U	0.50 U	5.3	0.50 U	5.0 U	0.50 U
vinyl chloride	2	5.0 U	0.50 U	0.093 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
xylenes	10,000	72.0	0.50 U	0.050 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	5.0 U	0.50 U
Inorganics (µg/L)																			
aluminum		N/A	N/A	N/A	N/A	N/A	200 U	N/A	N/A	200 U	200 U	N/A	N/A	200 U	N/A	N/A	N/A	N/A	N/A
antimony	6	N/A	N/A	N/A	N/A	N/A	60.0 U	N/A	N/A	4.9 J	60.0 U	N/A	N/A	60.0 U	N/A	N/A	N/A	N/A	N/A
arsenic	10	N/A	N/A	N/A	N/A	N/A	41.4	N/A	N/A	139	35.5	N/A	N/A	7.3 J	N/A	N/A	N/A	N/A	N/A
barium	2,000	N/A	N/A	N/A	N/A	N/A	168 J	N/A	N/A	481	633	N/A	N/A	216	N/A	N/A	N/A	N/A	N/A
cadmium	5	N/A	N/A	N/A	N/A	N/A	0.20 J	N/A	N/A	5.0 U	5.0 U	N/A	N/A	5.0 U	N/A	N/A	N/A	N/A	N/A
calcium		N/A	N/A	N/A	N/A	N/A	23,800	N/A	N/A	173,000	146,000	N/A	N/A	33,900	N/A	N/A	N/A	N/A	N/A
chromium	100	N/A	N/A	N/A	N/A	N/A	0.70 J	N/A	N/A	3.2 J	2.1 J	N/A	N/A	1.4 J	N/A	N/A	N/A	N/A	N/A
cobalt		N/A	N/A	N/A	N/A	N/A	50.0 U	N/A	N/A	50.0 U	0.70 J	N/A	N/A	50.0 U	N/A	N/A	N/A	N/A	N/A
copper	1,300(3)	N/A	N/A	N/A	N/A	N/A	25.0 U	N/A	N/A	25.0 U	25.0 U	N/A	N/A	25.0 U	N/A	N/A	N/A	N/A	N/A
iron		N/A	N/A	N/A	N/A	N/A	22,700	N/A	N/A	74,900	66,800	N/A	N/A	42,400	N/A	N/A	N/A	N/A	N/A
lead	15(3)	N/A	N/A	N/A	N/A	N/A	3.0 U	N/A	N/A	3.0 U	3.0 U	N/A	N/A	3.0 U	N/A	N/A	N/A	N/A	N/A
magnesium		N/A	N/A	N/A	N/A	N/A	2,560 J	N/A	N/A	18,800	17,100	N/A	N/A	5,290	N/A	N/A	N/A	N/A	N/A
manganese		N/A	N/A	N/A	N/A	N/A	415	N/A	N/A	343	275	N/A	N/A	752	N/A	N/A	N/A	N/A	N/A
mercury	2	N/A	N/A	N/A	N/A	N/A	0.20 U	N/A	N/A	0.20 U	0.20 U	N/A	N/A	0.20 U	N/A	N/A	N/A	N/A	N/A
nickel		N/A	N/A	N/A	N/A	N/A	7.5 J	N/A	N/A	11.9 J	8.5 J	N/A	N/A	2.2 J	N/A	N/A	N/A	N/A	N/A
potassium		N/A	N/A	N/A	N/A	N/A	3,750 J	N/A	N/A	22,800	21,300	N/A	N/A	4,640 J	N/A	N/A	N/A	N/A	N/A
sodium		N/A	N/A	N/A	N/A	N/A	11,000	N/A	N/A	57,900	59,900	N/A	N/A	2,200 J	N/A	N/A	N/A	N/A	N/A
thallium	2	N/A	N/A	N/A	N/A	N/A	4.4 J	N/A	N/A	2.3 J	4.1 J	N/A	N/A	4.2 J	N/A	N/A	N/A	N/A	N/A
vanadium		N/A	N/A	N/A	N/A	N/A	50.0 U	N/A	N/A	50.0 U	50.0 U	N/A	N/A	50.0 U	N/A	N/A	N/A	N/A	N/A
zinc		N/A	N/A	N/A	N/A	N/A	10.0 J	N/A	N/A	20.0 U	20.0 U	N/A	N/A	20.0 U	N/A	N/A	N/A	N/A	N/A
Others(6) (mg/L)																			
ethane		0.13	N/A	0.01 U	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ethene		0.06	N/A	0.01 U	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
methane		13.0	N/A	0.02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOC		29.2	N/A	0.26 U	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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2010 3-5 AnalyticalSummary-MontrWells.xlsx

Summary of Analytical Results for LF04 Groundwater Monitoring Wells (2010)

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

Location ID		LF4PR1	LF4PR2	LF4PR3	LF4PR4	LF4WP1	LF4WP7	LF4WP8	LF4WP9	LF4WP10	LF4WP11	LF4WP12	LSB5	LSB11	LSB13	LSB14	LSB15	RI1-2W	RI1-4W
Sample Date		4/15/2010	4/14/2010	4/14/2010	4/15/2010	4/15/2010	4/16/2010	4/15/2010	4/15/2010	4/16/2010	4/16/2010	4/16/2010	4/14/2010	4/15/2010	4/15/2010	4/15/2010	4/14/2010	4/15/2010	4/15/2010
Hydrogeologic Unit		LPROV	LPROV	UPROV	UPROV	PC	QUAT	QUAT	QUAT	QUAT	QUAT	QUAT	SURF	SURF	SURF	SURF	SURF	UPROV	UPROV
Screen		130 - 140	125 - 135	60 - 70	60 - 70	4.6 - 7.1	11.1 - 13.6	12.2 - 17.2	9.1 - 14.1	11.7 - 16.7	11.4 - 16.4	12 - 17	6 - 16	6.5 - 16.5	7 - 17	7 - 17	7 - 17	40 - 50	40 - 50
Sample Type	RL/MCL[1]	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
Volatile Organics (ug/L)																			
1,2-dichlorobenzene	600	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	3.6	1.9	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U
1,2-dichloroethane	5	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U
1,3-dichlorobenzene		0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0	0.53	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U
1,4-dichlorobenzene	75	0.50 U	0.50 U	0.50 U	0.50 U	5.8	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	18.0	7.6	6.1	1.8 J	6.1	0.50 U	0.50 U
2-butanone (MEK)		5.0 U	5.0 U	5.0 U	5.0 U	25.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	4.2 J	5.0 U	5.0 U	25.0 U	5.0 U	5.0 U	5.0 U
acetone		5.0 U	5.0 U	5.0 U	5.0 U	25.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	25.0 U	5.0 U	5.0 U	9.0
benzene	5	0.50 U	0.50 U	0.50 U	0.50 U	180	0.50 U	2.0	0.50 U	0.50 U	0.50 U	0.50 U	15.0	[illegible]	[illegible]	6.5	12.0	0.50 U	0.50 U
carbon tetrachloride	5	0.50 U	0.50 U	0.50 U	0.87	2.5 U	3.0	0.50 U	5.6	0.50 U	1.4	0.63	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	1.2	0.55
chlorobenzene	100	0.50 U	0.50 U	1.7	0.50 U	410	0.50 U	24.0	0.50 U	0.50 U	0.50 U	0.50 U	100	95.0	160	380	25.0	0.50 U	0.50 U
chloroethane		0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U
chloroform	80[4]	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U
cis-1,2-dichloroethene	70	0.50 U	0.50 UJ	0.50 U	0.50 U	2.5 U	3.7	1.4	12.0	0.50 UJ	4.6	0.50 UJ	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.65
cyclohexane		0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U
dichloromethane (methylene chloride)	5	0.50 UJ	0.50 U	0.50 U	0.50 UJ	3.5 U	0.50 U	0.50 U	0.50 UJ	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	3.5 J	0.50 U	0.50 UJ	0.50 UJ
ethylbenzene	700	0.50 U	0.50 U	0.50 U	0.50 U	1.7 J	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 UJ	0.50 U	0.50 U	0.50 U	2.2 J	0.50 U	0.50 U	0.50 U
isopropylbenzene		0.50 U	0.50 U	0.50 U	0.50 U	0.99 J	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 UJ	1.7	1.5	1.8	3.1	1.4	0.50 U	0.50 U
methylcyclohexane		0.50 U	0.50 U	0.50 U	0.50 U	1.5 J	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U
tetrachloroethene	5	0.50 U	0.50 U	0.50 U	0.62	2.5 U	15.0	1.5	7.0	0.50 U	2.8	1.7 J	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	15.0	4.7
toluene	1,000	0.50 U	0.50 U	0.50 U	0.50 U	1.4 J	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 UJ	0.50 U	0.33 J	0.50 U	7.2	0.50 U	0.50 U	0.50 U
trans-1,2-dichloroethene	100	0.50 U	0.50 UJ	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.58	0.50 UJ	0.50 U	0.50 UJ	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U
trichloroethene	5	0.50 U	0.50 U	0.50 U	2.3	2.5 U	36.0	15.0	16.0	0.50 U	14.0	3.9 J	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	61	2.4
vinyl chloride	2	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U
xylenes	10,000	0.50 U	0.50 U	0.50 U	0.50 U	14.0	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 UJ	1.9	0.50 U	1.4	19.0	0.50 U	0.50 U	1.3
Inorganics (ug/L)																			
aluminum		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	373	200 U	36.0 J	31.4 J	114 J	N/A	N/A
antimony	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	60.0 U	60.0 U	60.0 U	60.0 U	60.0 U	N/A	N/A
arsenic	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.0 U	6.9 J	10.0 U	16.3	99.5	N/A	N/A
barium	2,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,060	1,520	850	773	284	N/A	N/A
cadmium	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.6 J	5.0 U	0.30 J	1.3 J	0.70 J	N/A	N/A
calcium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	70,600	168,000	136,000	146,000	63,400	N/A	N/A
chromium	100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.0 J	3.6 J	9.5 J	7.6 J	12.3	N/A	N/A
cobalt		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.5 J	1.5 J	6.1 J	2.2 J	50.0 U	N/A	N/A
copper	1,300[3]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17.8 J	25.0 U	15.6 J	10.7 J	25.0 U	N/A	N/A
iron		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	57,700	77,600	39,200	32,300	68,300	N/A	N/A
lead	15[3]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.0 U	2.9 J	2.1 J	8.8	4.2	N/A	N/A
magnesium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	62,200	24,600	66,200	49,200	13,500	N/A	N/A
manganese		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	222	373	180	92.7	1,410	N/A	N/A
mercury	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.20 U	0.20 U	1.0	0.20 U	0.20 U	N/A	N/A
nickel		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	143	67.7	76.1	99.6	20.3 J	N/A	N/A
potassium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	64,500	45,600	72,900	99,200	16,500	N/A	N/A
sodium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	170,000	26,800	120,000	255,000	45,400	N/A	N/A
thallium	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]	[illegible]	[illegible]	2.7 J	[illegible]	N/A	N/A
vanadium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16.2 J	50.0 U	25.6 J	23.8 J	50.0 U	N/A	N/A
zinc		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	123	5.4 J	86.8	113	274	N/A	N/A
Other (mg/L)																			
ethane		N/A	N/A	N/A	N/A	N/A	0.01 U	N/A	0.01 U	0.01 U	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ethene		N/A	N/A	N/A	N/A	N/A	0.01 U	N/A	0.01 U	0.01 U	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
methane		N/A	N/A	N/A	N/A	N/A	0.02	N/A	0.31	0.02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOC		N/A	N/A	N/A	N/A	N/A	1.5	N/A	1.0 U	1.0 U	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table No. 3-5
Summary of Analytical Results for LF04 Groundwater Monitoring Wells (2010)

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

Location ID		RI1-6W	RI1-7W	RW1(2)	RW2(2)	RW3(2)	RW4(2)	RW5(2)	RW6(2)
Sample Date		4/15/2010	4/16/2010	4/14/2010	4/14/2010	4/14/2010	4/14/2010	4/14/2010	4/14/2010
Hydrogeologic Unit		UPROV	UPROV	QUAT	QUAT	QUAT	QUAT	QUAT	QUAT
Screen		14.1 - 23.7	26.2 - 35.8	22.5 - 32.5	19.8 - 29.8	17.8 - 22.8	22.5 - 27.5	16 - 26	20 - 30
Sample Type		NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
	RL/MCL(1)								
Volatile Organics (µg/L)									
1,2-dichlorobenzene	600	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,2-dichloroethane	5	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,3-dichlorobenzene		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
1,4-dichlorobenzene	75	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
2-butanone (MEK)		5.0 U	5.0 U	5.0 UJ	5.0 U	5.0 UJ	5.0 U	5.0 U	5.0 U
acetone		5.0 U	5.0 U	5.0 UJ	5.0 U	5.0 UJ	5.0 UJ	5.0 U	5.0 U
benzene	5	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
carbon tetrachloride	5	**3.7**	**4.0**	**0.66 J**	0.50 U	**0.85 J**	**3.1**	**29.4**	**4.0**
chlorobenzene	100	0.50 U	0.50 U	0.50 U	0.50 U	**3.1**	0.50 U	0.50 U	0.50 U
chloroethane		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
chloroform	80(4)	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
cis-1,2-dichloroethene	70	**0.41 J**	**1.4**	**1.9**	0.50 U	**17.0**	**2.8**	0.50 U	**0.71**
cyclohexane		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
dichloromethane (methylene chloride)	5	0.50 U	0.50 UJ	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
ethylbenzene	700	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
isopropylbenzene		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
methylcyclohexane		0.50 U	0.50 UJ	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
tetrachloroethene	5	**19.0**	**4.3**	**1.3**	0.50 U	**28.0**	**12.0**	**1.3**	**0.87**
toluene	1,000	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
trans-1,2-dichloroethene	100	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
trichloroethene	5	**17.0**	**18.0**	**2.5**	0.50 U	**30.0**	**20.0**	**2.2**	**1.7**
vinyl chloride	2	0.50 U	0.50 U	**43.0**	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
xylenes	10,000	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Inorganics (µg/L)									
aluminum		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
antimony	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
arsenic	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
barium	2,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
cadmium	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
calcium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
chromium	100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
cobalt		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
copper	1,300(3)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
iron		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
lead	15(3)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
magnesium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
manganese		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
mercury	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
nickel		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
potassium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
sodium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
thallium	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
vanadium		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
zinc		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Others(6) (mg/L)									
ethane		N/A	N/A	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
ethene		N/A	N/A	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
methane		N/A	N/A	**0.17**	**0.07**	**0.11**	**0.04**	**0.02**	**0.02**
TOC		N/A	N/A	2.0 U	1.0 U	**1.6**	1.0 U	**2.2**	1.0 U

Notes:
"J" - estimated concentration.
"U" - not detected (reported at detection limit).
"UJ" - not detected (estimated detection limit).
-- µg/L - micrograms per liter.
-- mg/L - milligrams per liter.
-- RL - Remedial Level.
-- MCL - Maximum Contaminant Level.
-- N/A indicates parameter not analyzed and/or value not available.
-- Bolded values indicate detections.
-- Shaded areas indicate concentrations at or exceeding the RL/MCL.
-- Screened intervals are given in feet below ground surface.
(1) If not otherwise specified, RLs are equal to MCLs for Drinking Water (2009 Edition of the Drinking Water Standards and Health Advisories).
(2) RW1 through RW6 analytical results are included in this table since they were used for monitoring purposes only during this reporting period.
(3) MCL is the tap action level.
(4) Value based on the MCL of total Trihalomethanes (THMs).
(5) LF4-17 is sampled on a biennial schedule and was not scheduled for sampling in 2010. However, in support of the MNA study, the well was sampled, and the sample was analyzed for volatile organics using method SW8260.
(6) Samples analyzed by Sirem Laboratory in Guelph, Canada for ethane, ethene, and methane and by Gulf Coast Analytical Laboratories in Baton Rouge, Louisiana for TOC in support of the MNA study.
Hydrogeologic units:
SURF - Surficial.
PC - Peat/Clay.
QUAT - Quaternary Alluvium.
UPROV - Upper Providence.
LPROV - Lower Providence.
BLUFF - Blufftown.
Sample type:
NORM - Normal.

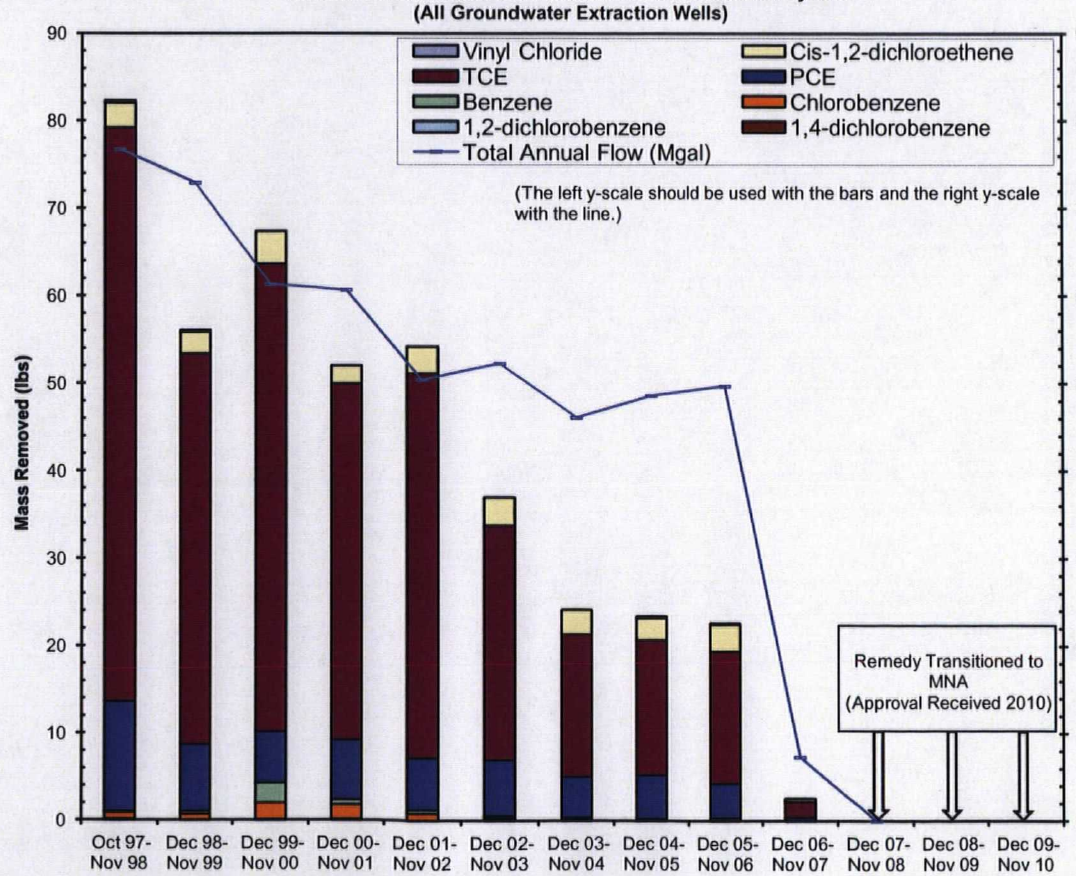
Table No. 3-6
Summary of Contaminant-Specific Mass Removal Estimates for Entire LF04 Groundwater Recovery System

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

Reporting Period	Total Annual Flow (gal)	1,2-dichlorobenzene Average Mass Removed (lbs)	1,4-dichlorobenzene Average Mass Removed (lbs)	Benzene Average Mass Removed (lbs)	Chlorobenzene Average Mass Removed (lbs)	Cis-1,2-dichloroethene Average Mass Removed (lbs)	PCE Average Mass Removed (lbs)	TCE Average Mass Removed (lbs)	Vinyl Chloride Average Mass Removed (lbs)	Total Organics Average Mass Removed (lbs)
Dec 2009 - Nov 2010	--	--	--	--	--	--	--	--	--	--
Dec 2008 - Nov 2009	--	--	--	--	--	--	--	--	--	--
Dec 2007 - Nov 2008	--	--	--	--	--	--	--	--	--	--
Dec 2006 - Nov 2007	7,306,335	0.0	0.0	0.0	0.0	0.4	0.4	1.8	0.0	2.6
Dec 2005 - Nov 2006	49,680,720	0.0	0.0	0.0	0.3	3.1	4.0	15.1	0.2	22.7
Dec 2004 - Nov 2005	48,608,086	0.0	0.0	0.0	0.3	2.5	5.0	15.5	0.2	23.4
Dec 2003 - Nov 2004	46,104,333	0.0	0.0	0.2	0.2	2.8	4.7	16.3	0.0	24.2
Dec 2002 - Nov 2003	52,241,457	0.0	0.0	0.3	0.3	3.2	6.4	26.8	0.0	37.0
Dec 2001 - Nov 2002	50,402,798	0.0	0.0	0.5	0.8	3.1	5.9	44.0	0.0	54.2
Dec 2000 - Nov 2001	60,627,236	0.0	0.1	0.6	1.7	2.1	6.9	40.7	0.0	52.0
Dec 1999 - Nov 2000	61,265,292	0.0	0.1	2.3	1.9	3.7	5.9	53.4	0.0	67.4
Dec 1998 - Nov 1999	72,844,348	0.0	0.0	0.4	0.7	2.5	7.7	44.6	0.2	56.1
Oct 1997 - Nov 1998	76,681,957	0.0	0.2	0.2	0.7	2.8	12.6	65.5	0.2	82.3
Overall (1)	525,762,562	0.0	0.4	4.4	6.8	26.3	59.5	323.7	0.7	421.9

Notes:
Mgal - Million gallons.
-- Pump not operational in the given period of time.
(1) The sum of the masses of the individual reporting periods may not be equal to the overall mass due to rounding.
(2) Historical flows and mass removal estimates do not include any contribution associated with the LF04 leachate collection system (i.e., toe drain pumps).
(3) RW1 through RW6 began pumping in October 1997.
(4) RW1 was shut down, with regulatory approval, on 11 February 1999. RW1 was temporarily reactivated from 24 February 2005 to 1 June 2005 and from 12 January 2006 to 6 September 2006.
(5) RW2, RW3, and RW6 were shut down, with regulatory approval, on 14 May 2002.
(6) RW4 and RW5 were shut down, with regulatory approval, on 1 February 2007.

Historical Mass Removal Estimates for LF04 Remedial System
(All Groundwater Extraction Wells)



Cumulative Historical Mass Removal Estimates for LF04 Remedial System
(All Groundwater Extraction Wells)

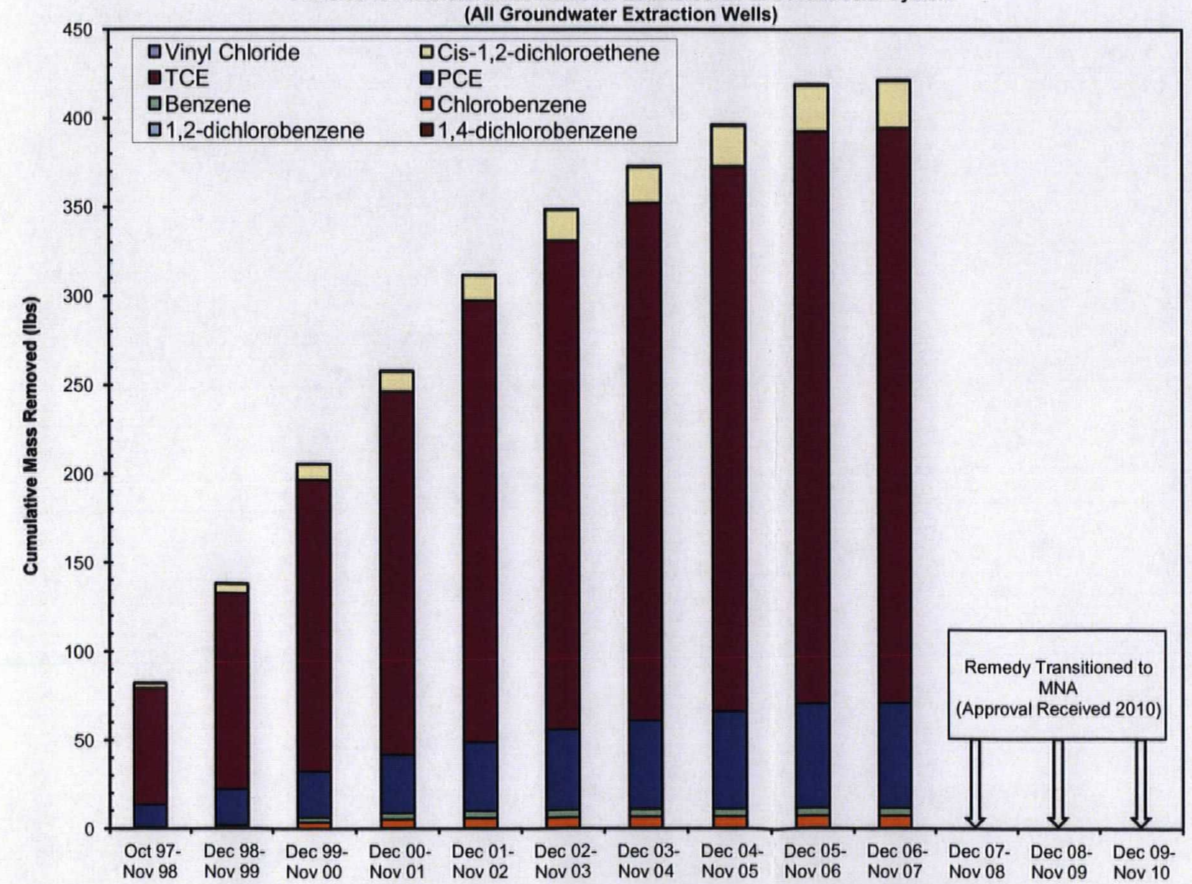


Table No. 3-7

Summary of Total Organics Mass Removal Rates for LF04 Groundwater Recovery System Components

GWTS Annual Progress Report (December 2009 - November 2010)

Robins Air Force Base, Georgia

	RW1 (1), (2)			RW2 (1), (3)			RW3 (1), (3)			RW4 (1), (4)			RW5 (1), (4)			RW6 (1), (3)			LF04 AREA TOTAL		
Reporting Period	Total Organics Removed (lbs)	Total Annual Flow (gal)	Organics Removal Rate (lbs/Mgal)	Total Organics Removed (lbs)	Total Annual Flow (gal)	Organics Removal Rate (lbs/Mgal)	Total Organics Removed (lbs)	Total Annual Flow (gal)	Organics Removal Rate (lbs/Mgal)	Total Organics Removed (lbs)	Total Annual Flow (gal)	Organics Removal Rate (lbs/Mgal)	Total Organics Removed (lbs)	Total Annual Flow (gal)	Organics Removal Rate (lbs/Mgal)	Total Organics Removed (lbs)	Total Annual Flow (gal)	Organics Removal Rate (lbs/Mgal)	Total Organics Removed (lbs)	Total Annual Flow (gal)	Organics Removal Rate (lbs/Mgal)
Dec 2009 - Nov 2010	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dec 2008 - Nov 2009	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dec 2007 - Nov 2008	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dec 2006 - Nov 2007	--	--	--	--	--	--	--	--	--	2.4	4,320,973	0.6	0.2	2,985,362	0.1	--	--	--	2.6	7,306,335	0.4
Dec 2005 - Nov 2006	1.2	8,269,204	0.1	--	--	--	--	--	--	19.7	25,746,096	0.8	1.7	15,665,421	0.1	--	--	--	22.7	49,680,720	0.5
Dec 2004 - Nov 2005	0.9	3,842,203	0.2	--	--	--	--	--	--	19.9	24,173,115	0.8	2.7	20,592,768	0.1	--	--	--	23.4	48,608,086	0.5
Dec 2003 - Nov 2004	--	--	--	--	--	--	--	--	--	20.7	27,433,472	0.8	3.5	18,670,862	0.2	--	--	--	24.2	46,104,333	0.5
Dec 2002 - Nov 2003	--	--	--	--	--	--	--	--	--	30.5	27,822,552	1.1	6.5	24,418,905	0.3	--	--	--	37.0	52,241,457	0.7
Dec 2001 - Nov 2002	--	--	--	0.9	4,432,142	0.2	1.6	5,781,913	0.3	23.8	15,900,186	1.5	26.0	18,555,348	1.4	1.9	5,733,209	0.3	54.2	50,402,798	1.1
Dec 2000 - Nov 2001	--	--	--	1.9	9,175,057	0.2	3.4	13,239,577	0.3	19.4	14,119,760	1.4	21.5	11,132,467	1.9	5.9	12,960,375	0.5	52.0	60,627,236	0.9
Dec 1999 - Nov 2000	--	--	--	1.3	9,640,637	0.1	2.7	13,402,874	0.2	11.8	13,686,912	0.9	42.3	12,087,731	3.5	9.3	12,447,138	0.7	67.4	61,265,292	1.1
Dec 1998 - Nov 1999	0.2	1,671,814	0.1	0.9	9,332,193	0.1	3.9	15,415,229	0.3	20.9	18,330,058	1.1	11.4	13,881,084	0.8	18.8	14,213,970	1.3	56.1	72,844,348	0.8
Oct 1997 - Nov 1998	1.2	8,991,794	0.1	1.8	9,109,819	0.2	4.5	16,918,510	0.3	29.6	16,874,663	1.8	19.4	12,225,317	1.6	25.8	12,561,854	2.1	82.3	76,681,957	1.1
Overall (5)	3.6	22,775,014	0.2	6.8	41,689,848	0.2	16.0	64,758,103	0.2	198.6	188,407,787	1.1	135.2	150,215,264	0.9	61.6	57,916,546	1.1	421.9	525,762,562	0.8

Notes:

Mgal - Million gallons.

-- Pump not operational in the given period of time.

(1) RW1 through RW6 began pumping in October 1997.

(2) RW1 was shut down, with regulatory approval, on 11 February 1999. RW1 was temporarily reactivated from 24 February 2005 to 1 June 2005 and from 12 January 2006 to 6 September 2006.

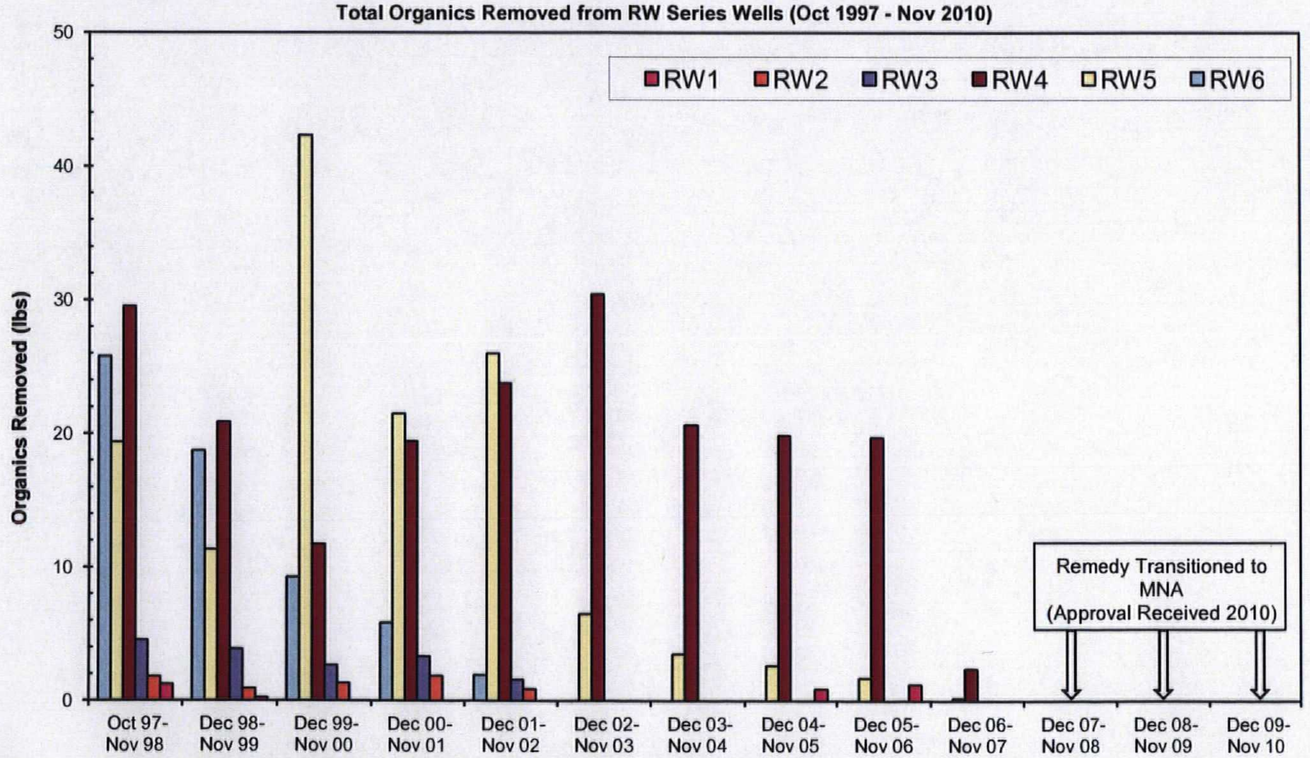
(3) RW2, RW3, and RW6 were shut down, with regulatory approval, on 14 May 2002.

(4) RW4 and RW5 were shut down, with regulatory approval, on 1 February 2007.

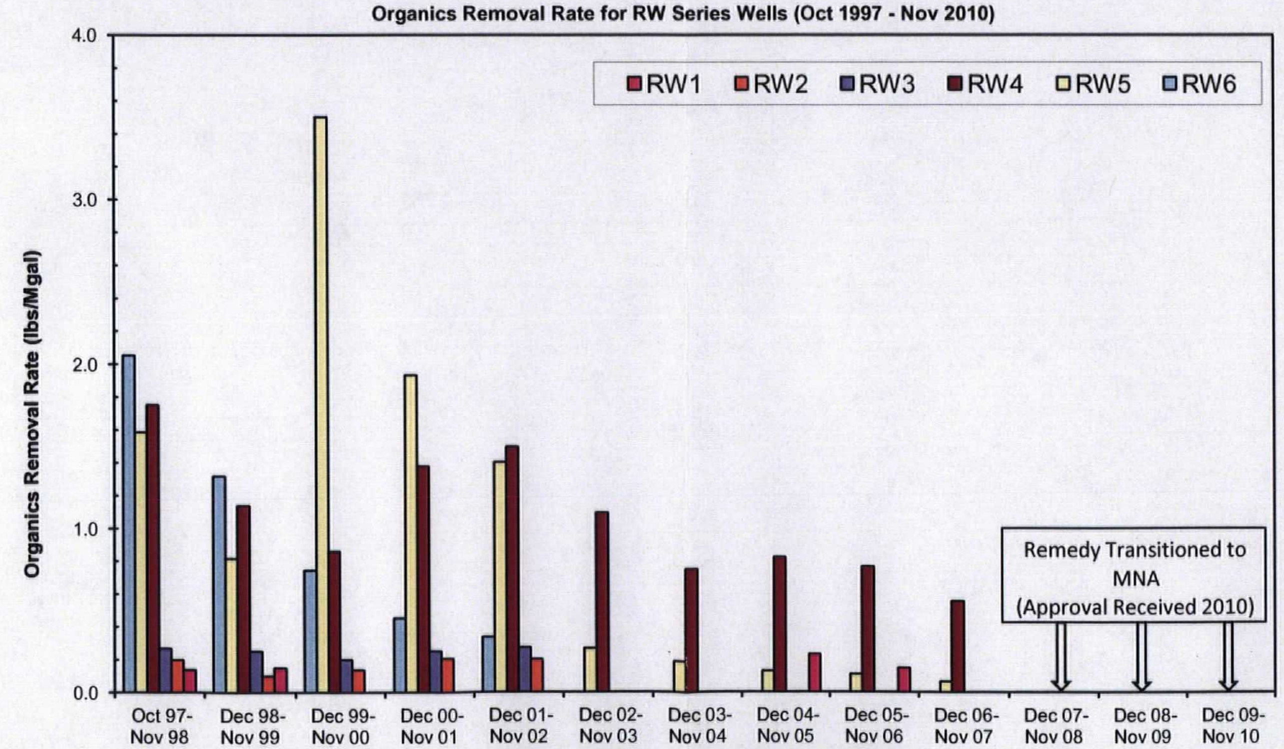
(5) The sum of the masses of the individual reporting periods may not be equal to the overall mass due to rounding.

(6) Historical flows and mass removal estimates do not include any contribution associated with the LF04 leachate collection system (i.e., toe drain pumps).

Total Organics Removed from RW Series Wells (Oct 1997 - Nov 2010)



Organics Removal Rate for RW Series Wells (Oct 1997 - Nov 2010)



GA100539
2010.3-6 and 3-7 HistMassRemoval.xlsx

Table No. 3-8
Summary of Geochemical Parameters and Chlorinated Ethenes in Groundwater at LF04

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

				Location	LF4-6	LF4-17	LF4WP7	LF4WP9	LF4WP10	RW1	RW2	RW3	RW4	RW5	RW6
				Sample Date	4/14/2010	4/16/2010	4/16/2010	4/15/2010	4/16/2010	4/14/2010	4/14/2010	4/14/2010	4/14/2010	4/14/2010	4/14/2010
	Parameter	Unit	MCL	Favorable[3]											
Field Measured Parameters[1]	Temperature	(°C)	--	> 20	18.90	18.70	17.96	18.44	18.67	21.02	20.85	20.47	21.69	25.87	23.67
	Dissolved Oxygen (DO)	(mg/L)	--	< 1.0	0.19	5.65	9.55	0.00	10.06	5.00	7.05	0.00	4.60	4.70	5.90
	Oxidation-Reduction Potential (ORP)	(mV)	--	< 0	-203	328	240	168	291	270	233	300	270	189	228
	pH	(s.u.)	--	6 < pH < 9	6.40	4.87	4.99	4.87	5.07	4.86	4.95	4.72	4.74	5.33	5.27
Laboratory Measured Parameters[2]	Methane	(mg/L)	--	> 1.0	**13**	**0.02**	**0.02**	**0.31**	**0.02**	**0.17**	**0.07**	**0.11**	**0.04**	**0.02**	**0.02**
	Ethane	(mg/L)	--	> 0.01	**0.13**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
	Ethene	(mg/L)	--	> 0.01	**0.06**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
	TOC	(mg/L)	--	> 25	**29.2**	0.26 U	**1.5**	1.0 U	1.0 U	2.0 U	1.0 U	**1.6**	1.0 U	**2.2**	1.0 U
Chlorinated Ethenes[4][5][6]	tetrachloroethene	(µg/L)	5		5.0 U	0.12 U	**15.0**	**7.0**	0.5 U	**1.3**	0.5 U	**8.0**	**12.0**	**1.3**	**0.87**
	trichloroethene	(µg/L)	5		5.0 U	**4.68 J**	**36.0**	**18.0**	0.5 U	**2.5**	0.5 U	**30.0**	**20.0**	**2.2**	**1.7**
	cis-1,2-dichloroethene	(µg/L)	70	[illegible]	**74.0**	**1.47 J**	**3.7**	**12.0**	0.5 UJ	**1.9**	0.5 U	**17.0**	**2.8**	0.5 U	**0.71**
	trans-1,2-dichloroethene	(µg/L)	100	[illegible]	5.0 U	0.11 U	0.5 U	**0.58**	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	vinyl chloride	(µg/L)	2	[illegible]	5.0 U	0.093 U	0.5 U	0.5 U	0.5 U	**43.0**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Notes:

Data qualifiers:

"J" - estimated concentration.

"U" - not detected (reported at detection limit).

"UJ" - not detected (estimated detection limit).

-- °C - degree Celsius.

-- mg/L - milligrams per liter.

-- mV - millivolt.

-- s.u. - standard unit.

-- µg/L - micrograms per liter.

-- MCL - Maximum Contaminant Level.

-- Bolded values indicate detections.

-- Shaded areas indicate concentrations exceeding the MCL.

(1) Measured during the basewide sampling event in April 2010.

(2) Samples analyzed by Sirem Laboratory in Guelph, Canada for ethane, ethene, and methane and by Gulf Coast Analytical Laboratories in Baton Rouge, Louisiana for TOC in support of the MNA study.

(3) "Favorable" conditions tend to support reductive dechlorination.

(4) Chlorinated ethene concentrations were obtained from groundwater samples collected during the basewide sampling event in April 2010 and analyzed by Gulf Coast Analytical Laboratories.

(5) Detection of degradation products (i.e., cis-1,2-/trans-1,2-dichloroethene, vinyl chloride, and ethene) of PCE and TCE indicates reductive dechlorination is occurring. Detected values for these are necessary to support reductive dechlorination of parent compounds through biodegradation.

(6) LF4-17 is sampled on a biennial schedule and was not scheduled for sampling in 2010. However, in support of the MNA study, the well was sampled, and the sample was analyzed for volatile organics using method SW8260.

FIGURES

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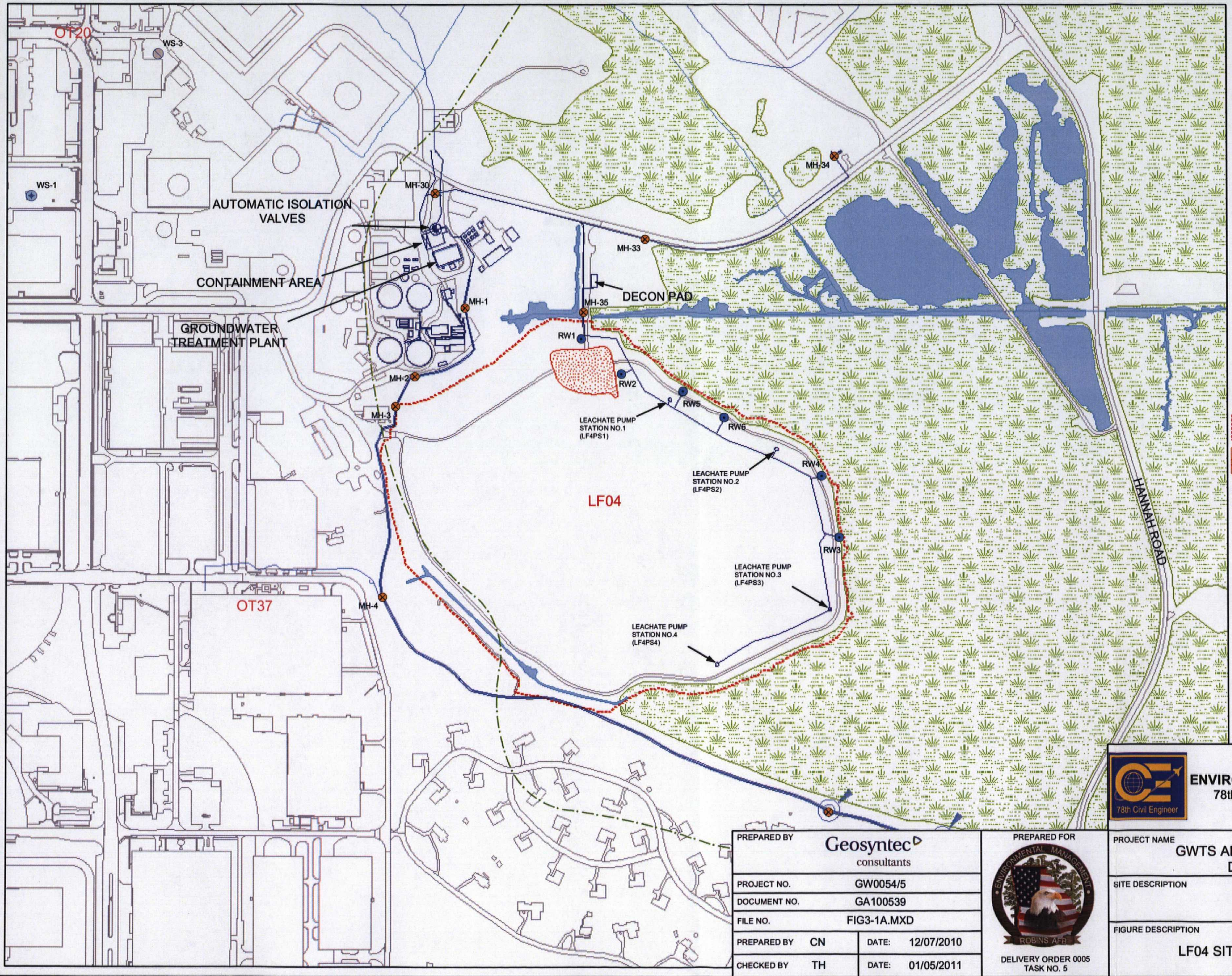


N

LEGEND

- RECOVERY WELL (INACTIVE)
- WATER SUPPLY WELL
- WATER SUPPLY WELL (DECOMMISSIONED)
- MANHOLE
- APPROX QUATERNARY ALLUVIUM CONTACT
- EXTRACTION WELL PIPING
- LF04 BOUNDARY
- FORMER SLUDGE LAGOON (WP 14)
- WETLAND AREAS

0 200 400 800 Feet

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

78th Civil Engineer

PREPARED BY	Geosyntec consultants
PROJECT NO.	GW0054/5
DOCUMENT NO.	GA100539
FILE NO.	FIG3-1A.MXD
PREPARED BY	CN — DATE: 12/07/2010
CHECKED BY	TH — DATE: 01/05/2011

PREPARED FOR

DELIVERY ORDER 0005
TASK NO. 5

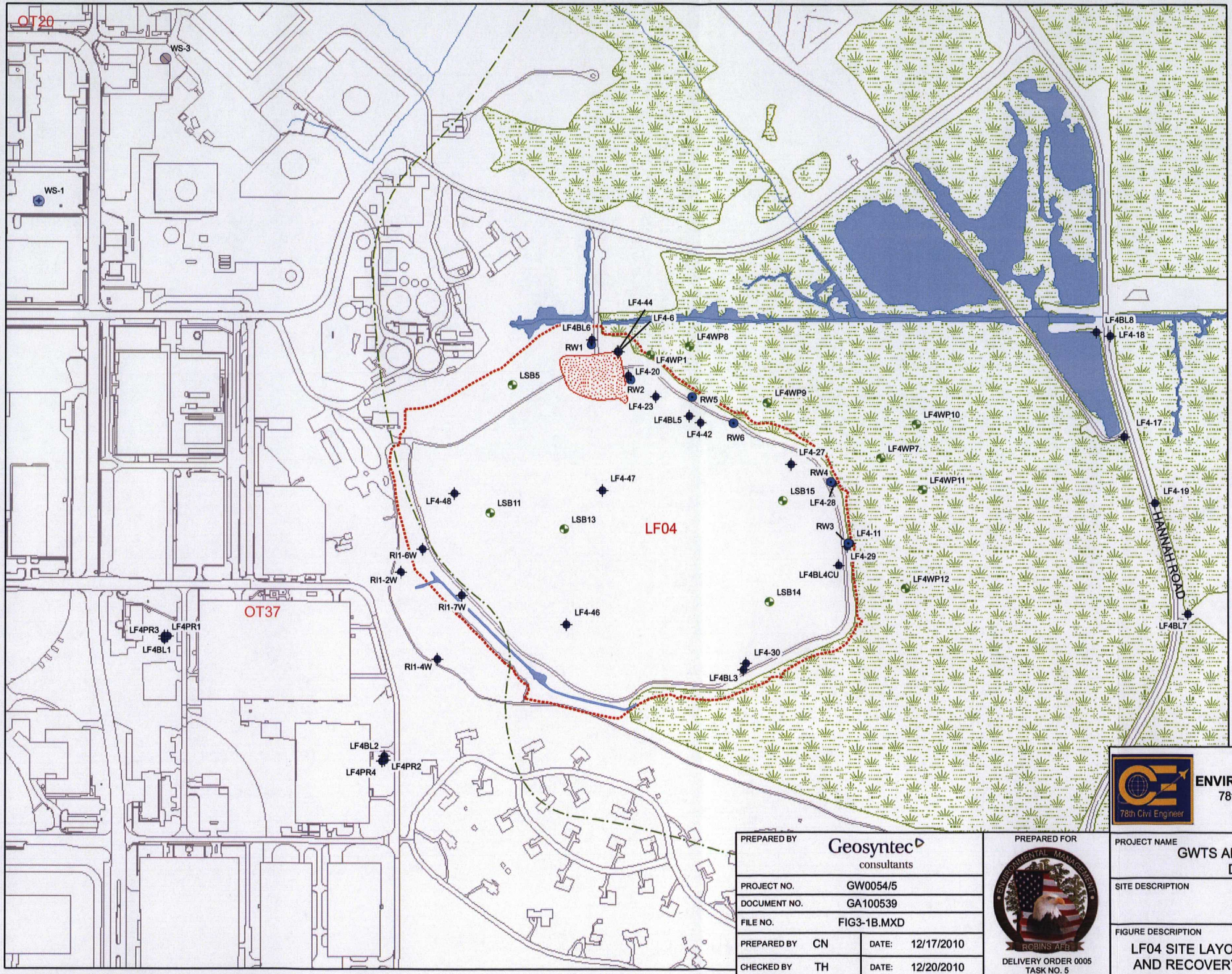
PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
LF04 SITE LAYOUT

FIGURE NO.
3-1A

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04



N

LEGEND

- RECOVERY WELL (INACTIVE)
- MONITORING WELL
- PIEZOMETER
- WATER SUPPLY WELL
- WATER SUPPLY WELL (DECOMMISSIONED)
- APPROX QUATERNARY ALLUVIUM CONTACT
- LF04 BOUNDARY
- FORMER SLUDGE LAGOON (WP 14)
- WETLAND AREAS

0 200 400 800 Feet

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG3-1B.MXD		
PREPARED BY	CN	DATE:	12/17/2010
CHECKED BY	TH	DATE:	12/20/2010

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

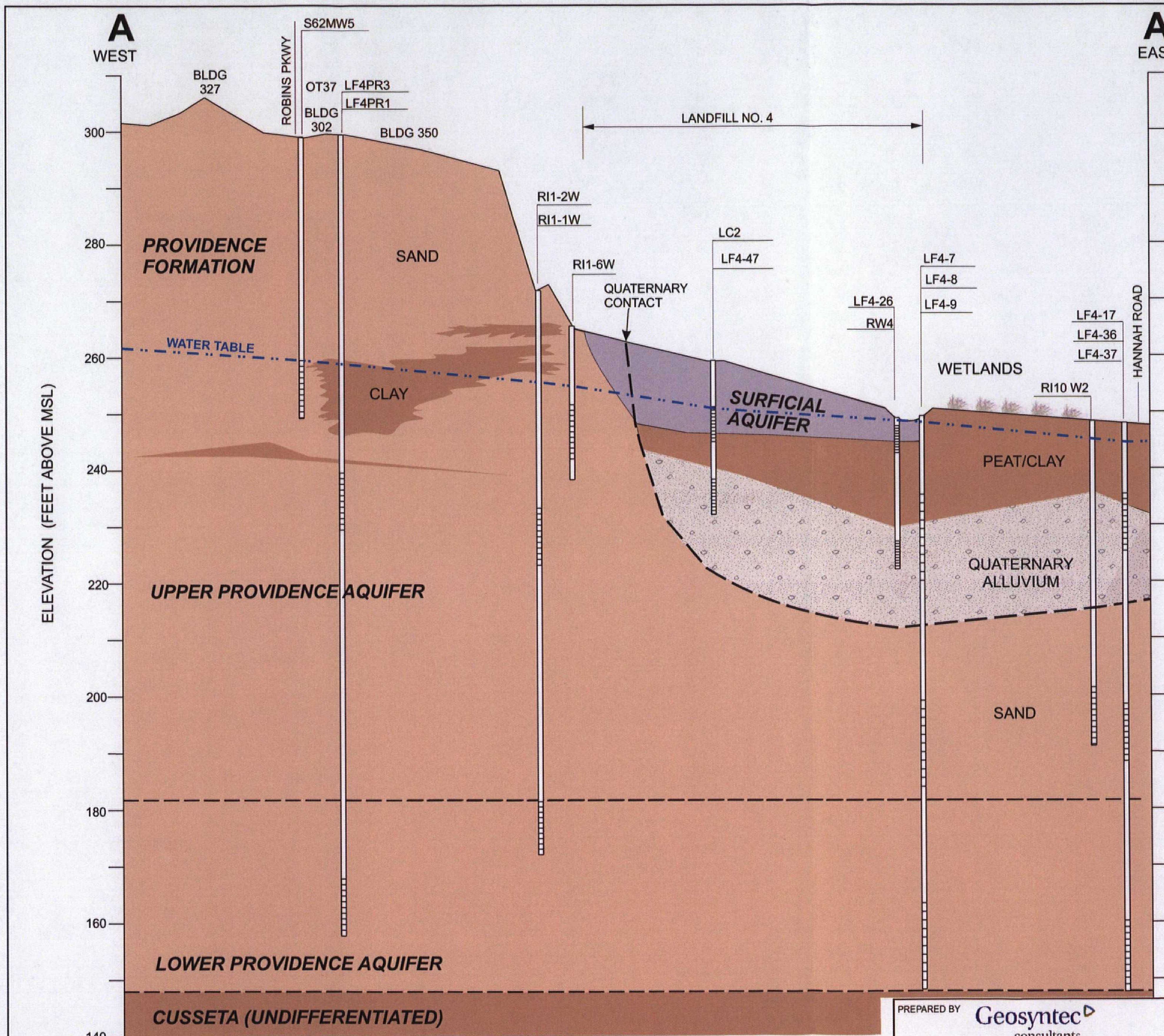
PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

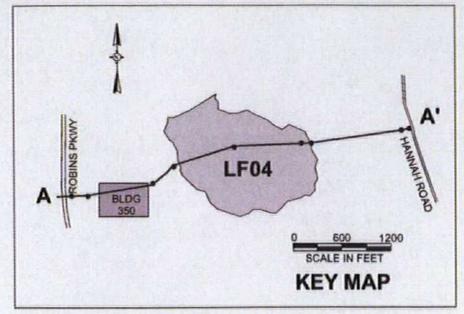
SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
LF04 SITE LAYOUT - MONITORING AND RECOVERY WELL NETWORK

FIGURE NO.
3-1B

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04





HOR 0 300 600

VER 0 10 20

SCALE IN FEET

NOTE:
1. THE WATER TABLE SHOWN ON THIS FIGURE IS BASED ON THE UPPER PROVIDENCE POTENTIOMETRIC SURFACE SHOWN ON FIGURE 3-5.

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG 3-2.CDR		
PREPARED BY	CN	DATE	01/05/2011
CHECKED BY	TH	DATE	01/21/2011

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

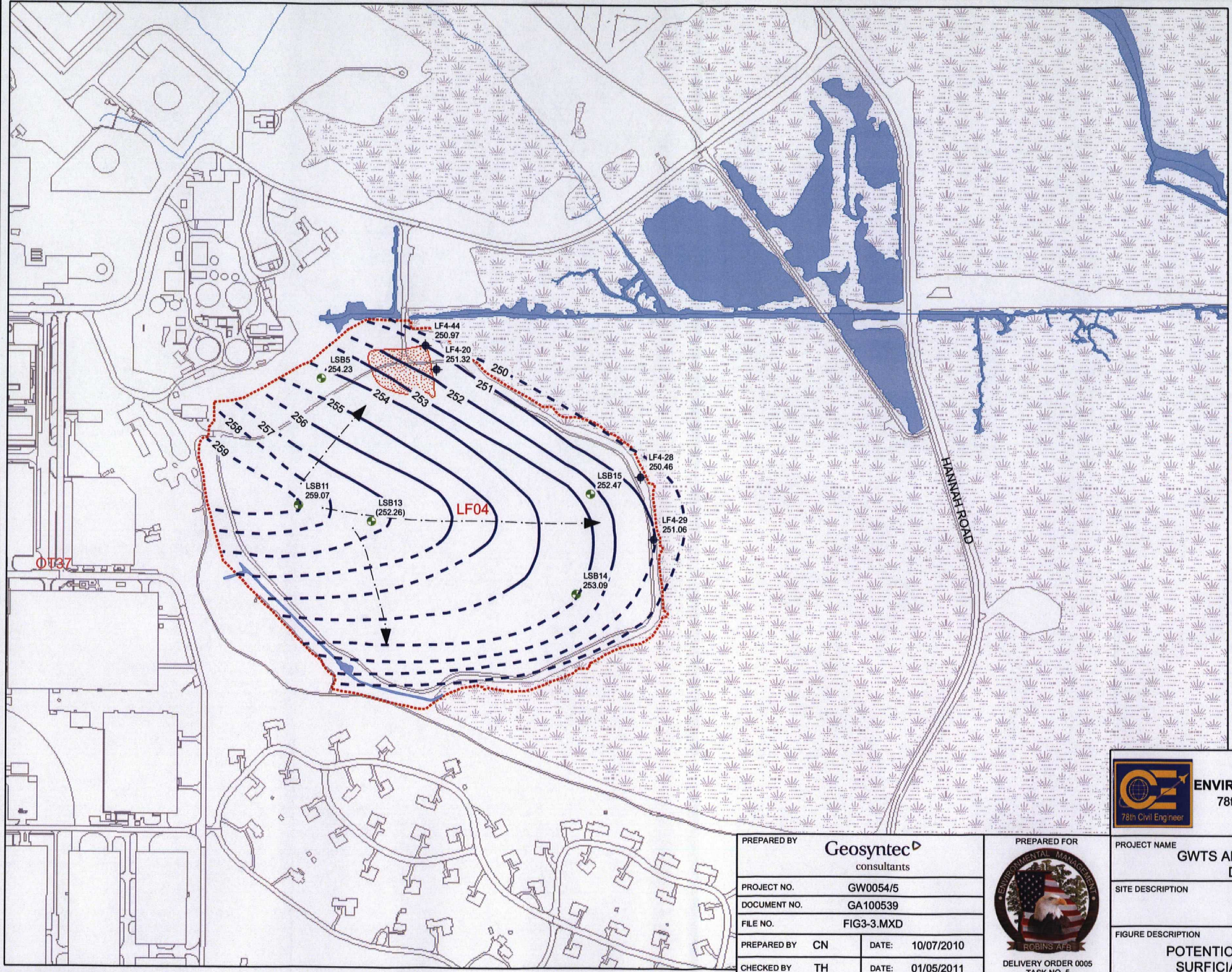
PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
LF04
HYDROGEOLOGIC CROSS-SECTION

FIGURE NO.
3-2

R:\Archive\Corel Data\ac-draw\a-projects\a-robins\GW0054



N

LEGEND

LF4-20 — WELL AND PIEZOMETER IDENTIFICATION

251.32 — GROUNDWATER ELEVATION (FT ABOVE MSL)

SURFICIAL MONITORING WELL

SURFICIAL PIEZOMETER

-252- GROUNDWATER ELEVATION CONTOUR (FT ABOVE MSL; inferred where dashed)

DIRECTION OF GROUNDWATER FLOW

APPROX QUATERNARY ALLUVIUM CONTACT

LF04 BOUNDARY

FORMER SLUDGE LAGOON (WP 14)

NOTES:

1. *WATER LEVELS MEASURED APRIL 2010.*
2. *VALUES SHOWN IN ( ) NOT USED FOR CONTOURING.*

0 200 400 800 Feet

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

78th Civil Engineer

ABOVE THE FOE

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG3-3.MXD		
PREPARED BY	CN	DATE:	10/07/2010
CHECKED BY	TH	DATE:	01/05/2011

PREPARED FOR

ENVIRONMENTAL MANAGEMENT
ROBINS AFB

DELIVERY ORDER 0005
TASK NO. 5

PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
POTENTIOMETRIC MAP
SURFICIAL AQUIFER

FIGURE NO.
3-3

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04

LEGEND

LF4-18 / 244.99 — WELL AND PIEZOMETER IDENTIFICATION; GROUNDWATER ELEVATION (FT ABOVE MSL)

ALLUVIAL RECOVERY/ EXTRACTION WELL (INACTIVE)

ALLUVIAL MONITORING WELL

ALLUVIAL PIEZOMETER

-250- GROUNDWATER ELEVATION CONTOUR (FT ABOVE MSL; inferred where dashed)

DIRECTION OF GROUNDWATER FLOW

APPROX QUATERNARY ALLUVIUM CONTACT

LF04 BOUNDARY

FORMER SLUDGE LAGOON (WP 14)

NOTES:

1. *WATER LEVELS MEASURED APRIL 2010. NOTE THAT WATER LEVEL DATA FROM MONITORING WELLS AT SURROUNDING SITES WERE USED TO DEVELOP THE POTENTIOMETRIC CONTOURS.*
2. *VALUES SHOWN IN ( ) NOT USED FOR CONTOURING.*

0 200 400 800 Feet

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78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

78th Civil Engineer

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PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG3-4.MXD		
PREPARED BY	CN	DATE:	10/07/2010
CHECKED BY	TH	DATE:	12/14/2010

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ENVIRONMENTAL MANAGEMENT
ROBINS AFB
DELIVERY ORDER 0005
TASK NO. 5

PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
POTENTIOMETRIC MAP
ALLUVIAL AQUIFER

FIGURE NO.
3-4

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04

LEGEND

LF2-8 249.42 — WELL AND PIEZOMETER IDENTIFICATION / GROUNDWATER ELEVATION (FT ABOVE MSL)

UPPER PROVIDENCE EXTRACTION WELL

UPPER PROVIDENCE EXTRACTION WELL (INACTIVE)

UPPER PROVIDENCE MONITORING WELL

-256- GROUNDWATER ELEVATION CONTOUR (FT ABOVE MSL; inferred where dashed)

DIRECTION OF GROUNDWATER FLOW

APPROX QUATERNARY ALLUVIUM CONTACT

LF04 BOUNDARY

FORMER SLUDGE LAGOON (WP 14)

NOTE:

1. *WATER LEVELS MEASURED APRIL 2010. NOTE THAT WATER LEVEL DATA FROM MONITORING WELLS AT SURROUNDING SITES WERE USED TO DEVELOP THE POTENTIOMETRIC CONTOURS.*
2. *VALUES SHOWN IN ( ) NOT USED FOR CONTOURING.*

0 200 400 800 Feet

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PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG3-5.MXD		
PREPARED BY	CN	DATE:	10/07/2010
CHECKED BY	TH	DATE:	01/18/2011

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
POTENTIOMETRIC MAP
UPPER PROVIDENCE AQUIFER

FIGURE NO.
3-5

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04

N

LEGEND

LF4PR1 258.8 — WELL IDENTIFICATION; GROUNDWATER ELEVATION (FT ABOVE MSL)

LOWER PROVIDENCE MONITORING WELL

-256- GROUNDWATER ELEVATION CONTOUR (FT ABOVE MSL; inferred where dashed)

DIRECTION OF GROUNDWATER FLOW

APPROX QUATERNARY ALLUVIUM CONTACT

LF04 BOUNDARY

FORMER SLUDGE LAGOON (WP 14)

NOTE:
1. WATER LEVELS MEASURED APRIL 2010. NOTE THAT WATER LEVEL DATA FROM MONITORING WELLS AT SURROUNDING SITES WERE USED TO DEVELOP THE POTENTIOMETRIC CONTOURS.

0 200 400 800 Feet

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PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG3-6.MXD		
PREPARED BY	CN	DATE:	10/07/2010
CHECKED BY	TH	DATE:	12/14/2010

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
POTENTIOMETRIC MAP
LOWER PROVIDENCE AQUIFER

FIGURE NO.
3-6

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04

N

LEGEND

LF4-17 — WELL OR PIEZOMETER IDENTIFICATION
4.7 J — TCE CONCENTRATION (ug/L)

ALLUVIAL RECOVERY WELL (INACTIVE)

ALLUVIAL MONITORING WELL

ALLUVIAL PIEZOMETER

5 — TCE CONCENTRATION CONTOUR (ug/L; inferred where dashed)

APPROX QUATERNARY ALLUVIUM CONTACT

LF04 BOUNDARY

FORMER SLUDGE LAGOON (WP 14)

NOTES:

1. *SAMPLES COLLECTED APRIL 2010.*
2. *J - ESTIMATED VALUE*
3. *U - UNDETECTED; SHOWN AT DETECTION LIMIT VALUE*
4. *THE MCL FOR TCE IS 5 ug/L.*
5. *AERIAL PHOTOGRAPH DATE: SEPTEMBER 2009.*

0 200 400 800 Feet

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

78th Civil Engineer

ABOVE THE FOE

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG3-7.MXD		
PREPARED BY	CN	DATE:	10/16/2010
CHECKED BY	TH	DATE:	12/14/2010

PREPARED FOR
ENVIRONMENTAL MANAGEMENT
ROBINS AFB
DELIVERY ORDER 0005
TASK NO. 5

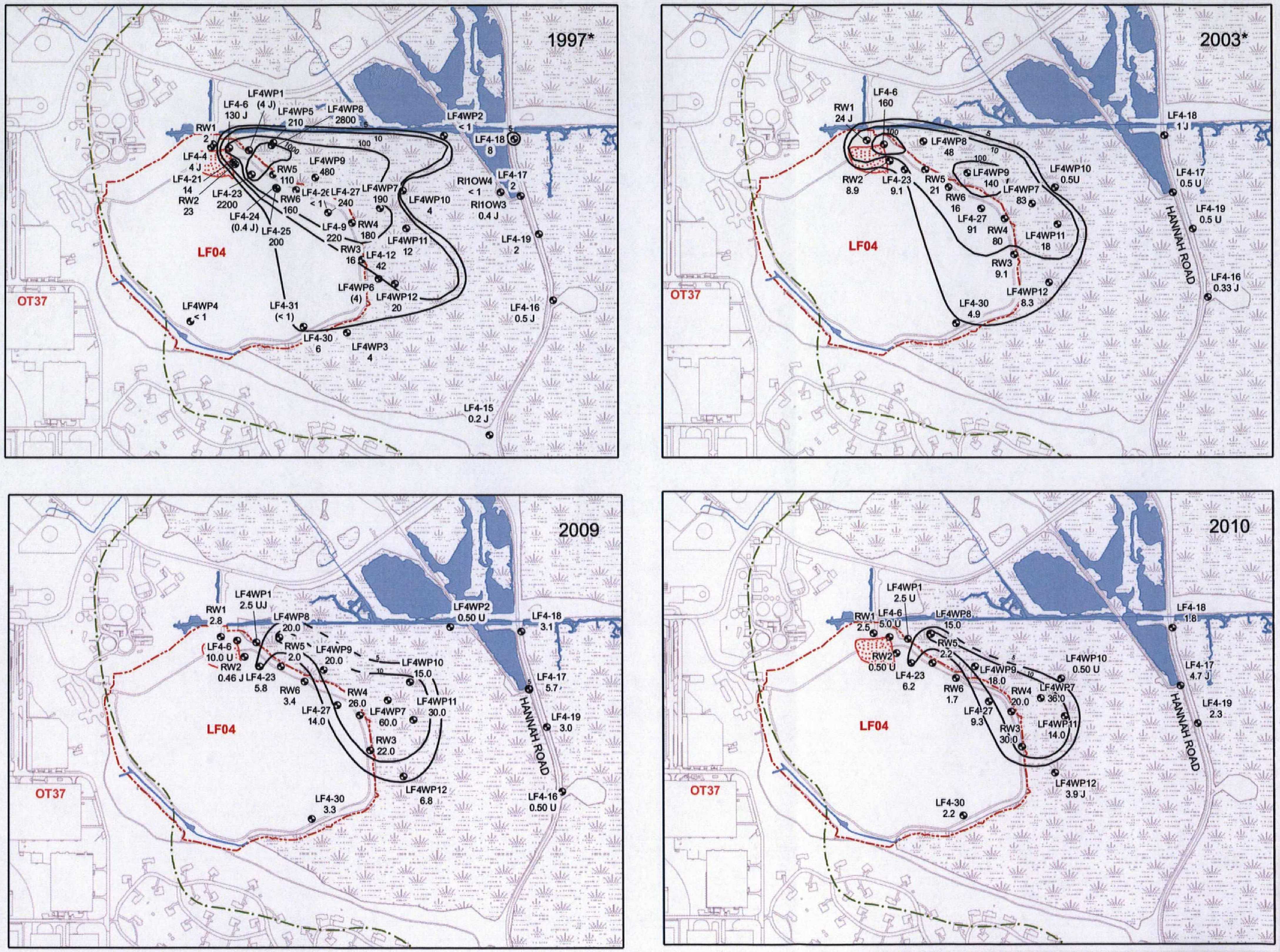
PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
TCE CONCENTRATIONS
ALLUVIAL AQUIFER

FIGURE NO.
3-7

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04



* Historic figures and data (1997 & 2003) originated from the 2002/2003 GWTS Annual Progress Report prepared by Earth Tech, Inc. (Project No. 62826).

N

LEGEND

LF4-17 — WELL OR PIEZOMETER IDENTIFICATION
4.7 J — TCE CONCENTRATION (ug/L)

ALLUVIAL WELL

5 — TCE CONCENTRATION CONTOUR (ug/L; inferred where dashed)

APPROX QUATERNARY ALLUVIUM CONTACT

LF04 BOUNDARY

FORMER SLUDGE LAGOON (WP 14)

NOTES:

1. *HISTORIC TCE CONCENTRATIONS REPORTED FOR 1997, 2003, 2009, AND 2010.*
2. *J - ESTIMATED VALUE*
3. *U - UNDETECTED; SHOWN AT DETECTION LIMIT VALUE*
4. *UJ - UNDETECTED (ESTIMATED DETECTION LIMIT)*
5. *VALUES SHOWN IN ( ) NOT USED FOR CONTOURING.*
6. *THE MCL FOR TCE IS 5 ug/L.*

0 400 800 1,600 Feet

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100538		
FILE NO.	FIG3-8.MXD		
PREPARED BY	CN	DATE:	12/17/2010
CHECKED BY	TH	DATE:	12/20/2010

PREPARED FOR

DELIVERY ORDER 0005
TASK NO. 5

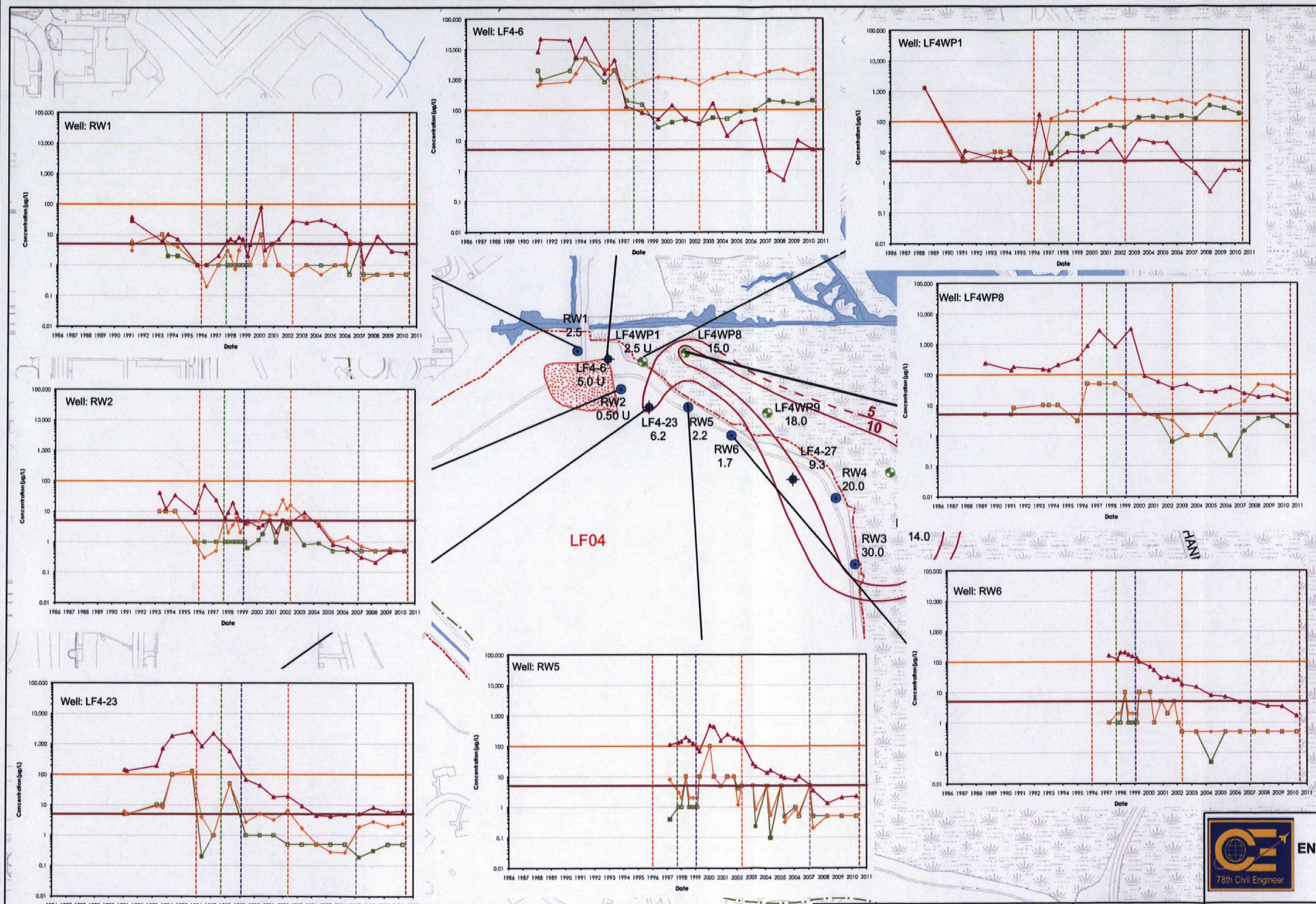
PROJECT NAME: GWTS ANNUAL PROGRESS REPORT DEC 2009 - NOV 2010

SITE DESCRIPTION: SWMU 4/LF04 ROBINS AFB, GEORGIA

FIGURE DESCRIPTION: HISTORICAL TCE CONCENTRATIONS ALLUVIAL AQUIFER

FIGURE NO. 3-8

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04



LEGEND

LF4-17 4.7 J — WELL OR PIEZOMETER IDENTIFICATION; TCE CONCENTRATION (ug/L)

- ALLUVIAL RECOVERY WELL (INACTIVE)
- ALLUVIAL MONITORING WELL
- ALLUVIAL PIEZOMETER
- 5 — TCE CONCENTRATION CONTOUR (ug/L; inferred where dashed)
- APPROX QUATERNARY ALLUVIUM CONTACT
- LF04 BOUNDARY
- FORMER SLUDGE LAGOON (WP 14)

NOTES:
1. *SAMPLES COLLECTED APRIL 2010.*
2. *J - ESTIMATED VALUE*
3. *U - UNDETECTED; SHOWN AT DETECTION LIMIT VALUE*
4. *FULL SIZE TIME TREND PLOTS ARE PRESENTED IN APPENDIX C.*
5. *OPEN SYMBOLS PRESENTED ON THE TIME TREND GRAPHS ARE NON-DETECTS, PRESENTED AT THE REPORTED DETECTION LIMIT.*

0 200 400 800 Feet

Time Trend Legend

- Benzene
- Chlorobenzene
- Trichlorobenzene
- Source Area Remediation (WP14 Treatment)
- Pumping well, RW1, Shutdown
- Pumping wells, RW4, RW5, Shutdown
- Benzene MCL: 5 ug/L
- Chlorobenzene MCL: 100 ug/L
- Trichloroethene MCL: 5 ug/L
- Pump System, Started
- Pumping well, RW2, RW3, RW6 and Toe Drains, Shutdown
- Site Remedy Transitioned to MNA

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG3-9A.MXD		
PREPARED BY	CN	DATE:	12/21/2010
CHECKED BY	TH	DATE:	01/05/2011

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

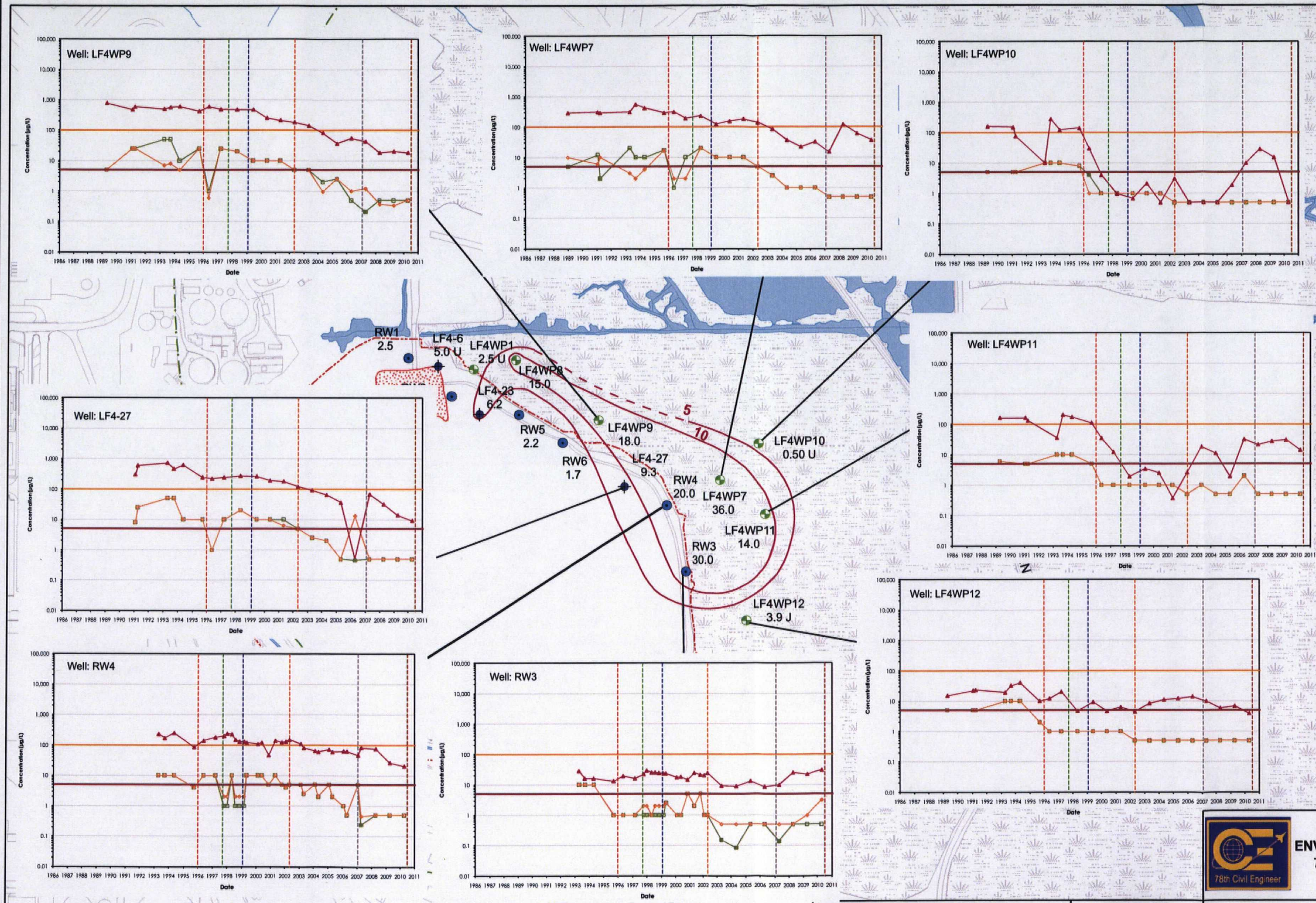
PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
TIME TREND CONTAMINANT CONCENTRATIONS ALLUVIAL AQUIFER - I

FIGURE NO.
3-9A

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04



LEGEND

LF4-17	WELL OR PIEZOMETER IDENTIFICATION
4.7 J	TCE CONCENTRATION (ug/L)
	ALLUVIAL RECOVERY WELL (INACTIVE)
	ALLUVIAL MONITORING WELL
	ALLUVIAL PIEZOMETER
5	TCE CONCENTRATION CONTOUR (ug/L; inferred where dashed)
	APPROX QUATERNARY ALLUVIUM CONTACT
	LF04 BOUNDARY
	FORMER SLUDGE LAGOON (WP 14)

NOTES:

1. *SAMPLES COLLECTED APRIL 2010.*
2. *J - ESTIMATED VALUE*
3. *U - UNDETECTED; SHOWN AT DETECTION LIMIT VALUE*
4. *FULL SIZE TIME TREND PLOTS ARE PRESENTED IN APPENDIX C.*
5. *OPEN SYMBOLS PRESENTED ON THE TIME TREND GRAPHS ARE NON-DETECTS, PRESENTED AT THE REPORTED DETECTION LIMIT.*

0 200 400 800 Feet

Time Trend Legend

- Benzene
- Chlorobenzene
- Trichlorobenzene
- Source Area Remediation (WP14 Treatment)
- Pumping well, RW1, Shutdown
- Pumping wells, RW4, RW5, Shutdown
- Benzene MCL: 5 ug/L
- Chlorobenzene MCL: 100 ug/L
- Trichloroethene MCL: 5 ug/L
- Pump System, Started
- Pumping well, RW2, RW3, RW6 and Toe Drains, Shutdown
- Site Remedy Transitioned to MNA

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG3-9B.MXD		
PREPARED BY	CN	DATE:	12/21/2010
CHECKED BY	TH	DATE:	01/05/2011

PREPARED FOR
ENVIRONMENTAL MANAGEMENT
ROBINS AFB
DELIVERY ORDER 0005
TASK NO. 5

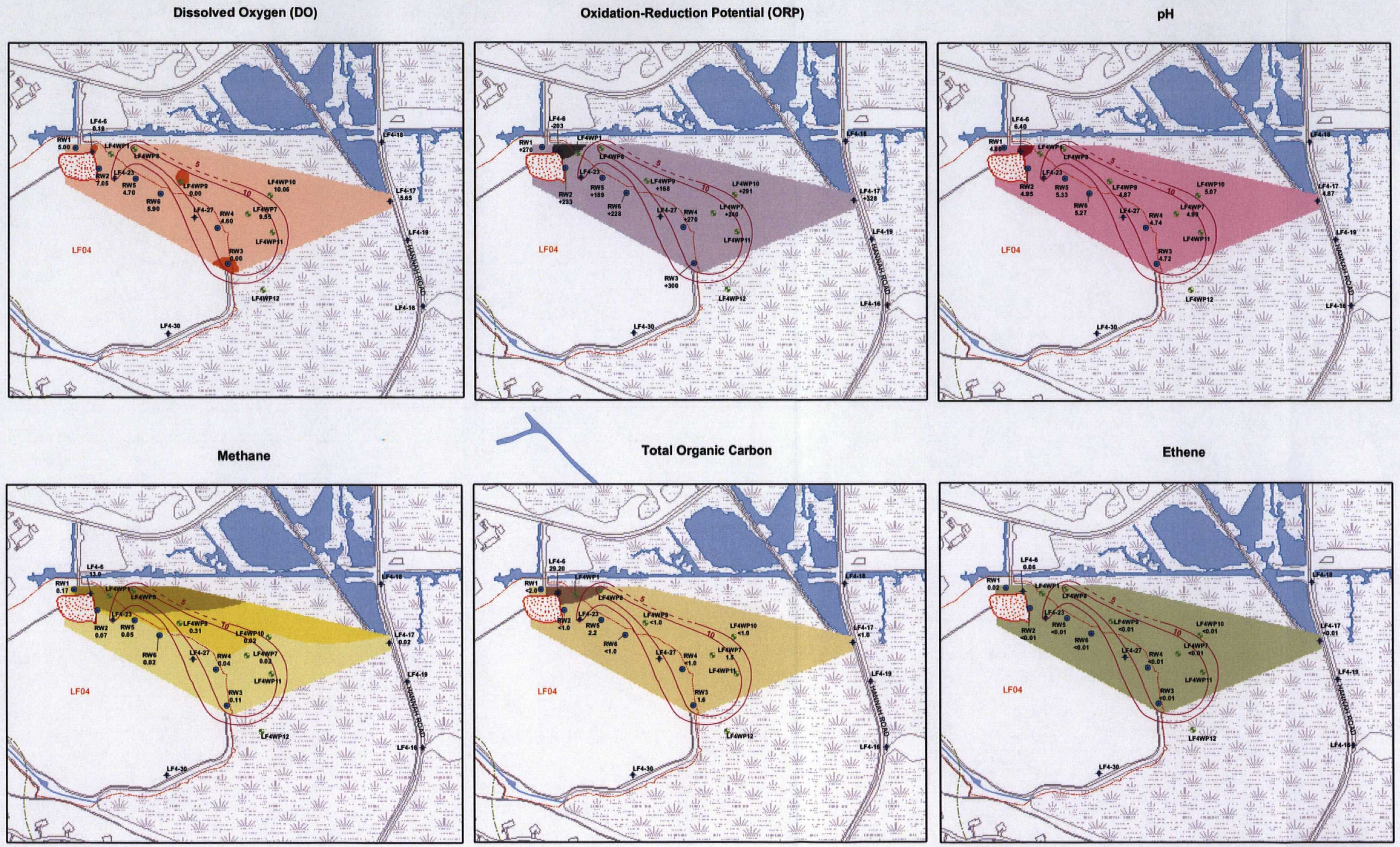
PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
TIME TREND CONTAMINANT CONCENTRATIONS ALLUVIAL AQUIFER - II

FIGURE NO.
3-9B

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04



N

LEGEND

LF4WP10 / 5.07 — WELL OR PIEZOMETER IDENTIFICATION; VALUE OF GEOCHEMICAL PARAMETER

ALLUVIAL RECOVERY WELL (INACTIVE)

ALLUVIAL MONITORING WELL

ALLUVIAL PIEZOMETER

5 — TCE CONCENTRATION CONTOUR (ug/L; inferred where dashed)

APPROX QUATERNARY ALLUVIUM CONTACT

LF04 BOUNDARY

FORMER SLUDGE LAGOON (WP 14)

NOTES:

1. *GEOCHEMICAL PARAMETERS WERE COLLECTED APRIL 2010.*
2. *RESULTS OF GEOCHEMICAL PARAMETERS ARE SHOWN ONLY AT LOCATIONS WHERE GROUNDWATER WAS SAMPLED.*

0 400 800 1,600 Feet

Field Measured Parameters

DO
- < 1 mg/L
- > 1 mg/L

ORP
- < 0 mV (Anaerobic)
- > 0 mV (Aerobic)

pH
- < 6 s.u.
- 6 - 7 s.u.

Laboratory Analyzed Parameters

Methane
- 0.01 - 0.1 mg/L
- 0.1 - 1 mg/L
- 1 - 10 mg/L

Total Organic Carbon
- 0.01 - 10 mg/L
- 10 - 25 mg/L
- 25 - 50 mg/L

Ethene
- > 0.10 mg/L
- ≤ 0.10 mg/L

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants
PROJECT NO.	GW0054/5
DOCUMENT NO.	GA100539
FILE NO.	FIG3-10.MXD
PREPARED BY	CN — DATE: 12/17/2010
CHECKED BY	TH — DATE: 12/20/2010

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

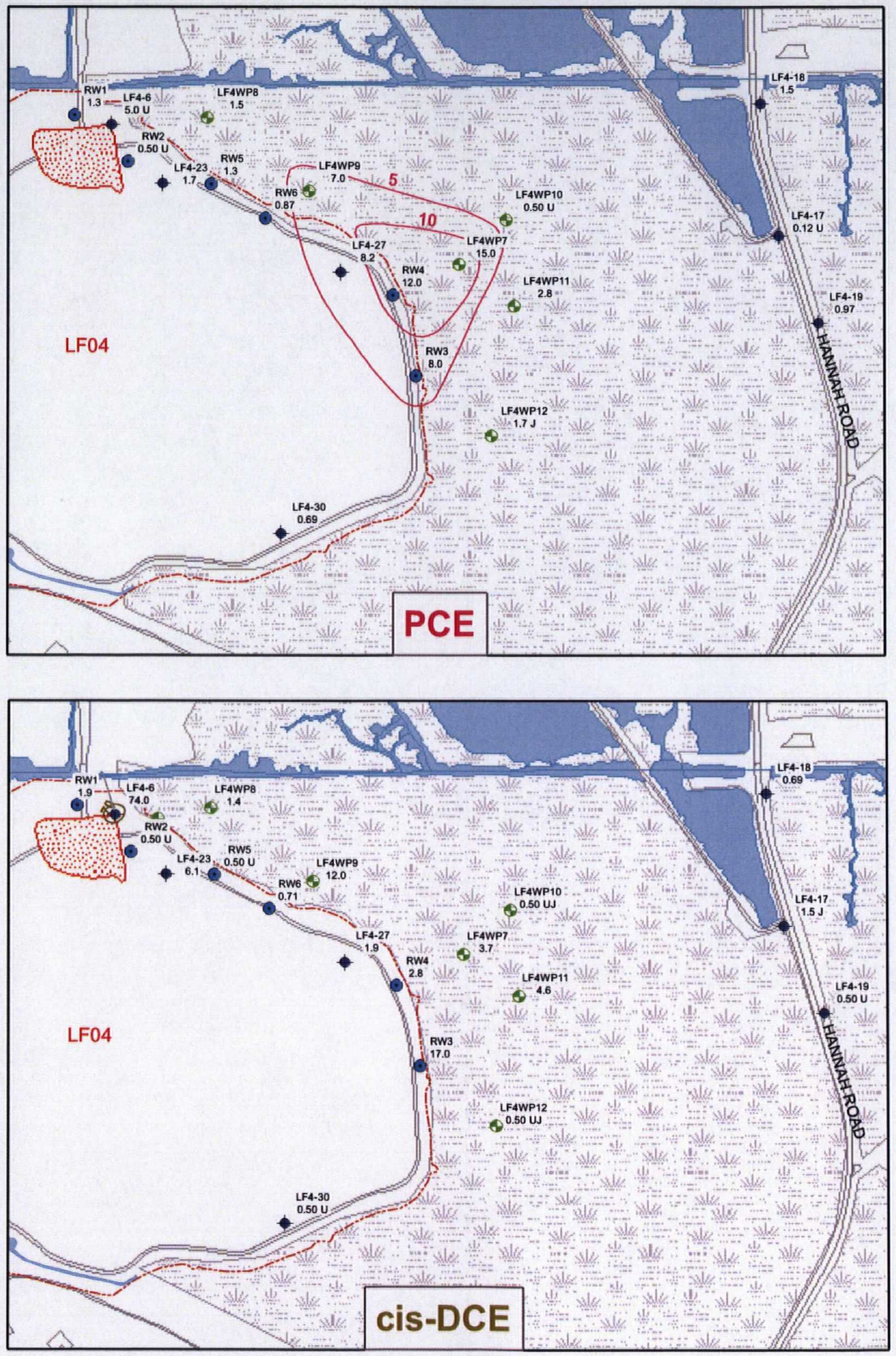
PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
INVESTIGATION OF GEOCHEMICAL PARAMETERS

FIGURE NO.
3-10

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04



N

LEGEND

LF4-17 — WELL OR PIEZOMETER IDENTIFICATION
5.7 — CONCENTRATION (ug/L)

ALLUVIAL RECOVERY WELL (INACTIVE)

ALLUVIAL MONITORING WELL

ALLUVIAL PIEZOMETER

5 — CONCENTRATION CONTOUR (ug/L; inferred where dashed) (color varies with contaminant)

LF04 BOUNDARY

FORMER SLUDGE LAGOON (WP 14)

NOTES:

1. *SAMPLES COLLECTED APRIL 2010.*
2. *J - ESTIMATED VALUE*
3. *U - UNDETECTED; SHOWN AT DETECTION LIMIT VALUE*
4. *UJ - UNDETECTED (ESTIMATED DETECTION LIMIT)*
5. *MCLs FOR CHLORINATED ETHENES:*
   PCE - 5 ug/L;
   TCE - 5 ug/L;
   CIS-DCE - 70 ug/L; and
   VINYL CHLORIDE - 2 ug/L.

0 250 500 1,000 Feet

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	FIG3-11.MXD		
PREPARED BY	CN	DATE:	10/17/2010
CHECKED BY	TH	DATE:	12/14/2010

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009 - NOV 2010

SITE DESCRIPTION
SWMU 4/LF04
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
DISTRIBUTION OF CHLORINATED ETHENES IN ALLUVIAL AQUIFER

FIGURE NO.
3-11

F:\robinafb\GIS\mxd\GW0054_5_GWTS\03_LF04

10.0 GWTS – OVERALL SUMMARY AND CONCLUSIONS

This section summarizes the overall GWTS performance and related conclusions from a holistic point of view. The operational data and performance evaluations for individual components of the GWTS (i.e., six restoration sites and the GWTP) discussed in earlier sections are collectively presented and analyzed in this section to evaluate the GWTS performance in its entirety. Detailed conclusions and recommendations pertaining to specific restoration sites are presented in previous sections of this report.

10.1 REVIEW OF OVERALL GWTS FLOW TOTALS

Table 10-1A provides a chronological summary, both in tabular and graphical form, of monthly flow totals for the entire GWTS, including flows from the groundwater remediation systems associated with each site and total influent flows to the GWTP. As shown in Table 10-1A, approximately 323 million gallons of groundwater from the GWTS restoration sites (i.e., OT20, LF03, OT17, OT37 and OT41) were pumped to the GWTP. The GWTP corrected influent volume for the same period was roughly 328 million gallons. The difference between the GWTS and GWTP flow totals is probably attributable to the unmetered flow to the GWTP from the LF04 decon pad, AS/SVE condensate tanks, and the tanker unloading pad located at the GWTP and to variations in metering calibration. During this reporting period, approximately 81 percent of the flow was from groundwater systems associated with OT20 (51 percent) and OT17 (30 percent). Table 10-1B provides a chronological summary, both in tabular and graphical form, of historical annual flow totals. As shown on this table, an estimated 3.2 billion gallons of groundwater have been extracted and treated since the system began operating in 1997.

10.2 OVERALL GWTS MASS REMOVAL TOTALS

Table 10-2 summarizes the total organics mass removed from groundwater extracted during this reporting period. As shown in Table 10-2, 2,826 lbs of total organics mass were removed from the GWTS sites. Approximately 97 percent of the estimated total organics mass removed was from the systems associated with LF03 (77 percent), OT17 (13 percent), and OT20 (7 percent). A graphical presentation of mass removal and flow contributions from the GWTS sites is also presented in Table 10-2.

As shown in Table 10-2, in terms of mass removal efficiency, LF03 is, by far, the most efficient system with a removal efficiency of approximately 93.4 lbs/Mgal. The mass removal efficiency for OT17 is the second highest among the remaining sites at 3.8 lbs/Mgal. Roughly 66 percent of the LF03 mass removal can be attributed to the leachate collection wells. However, even with the leachate collection wells excluded, the remedial system at LF03 still provides the highest mass removal efficiency (32.7 lbs/Mgal) among the GWTS sites.

Historic mass removal estimates for groundwater extracted from the entire GWTS are summarized in Tables 10-3 and 10-4. Since the start of the GWTS operation, an estimated 31,493 lbs of total organics mass has been removed. Approximately 46 percent of the total organics mass removed since startup of the GWTS has been comprised of TCE (14,604 lbs). The total organics mass removed during this reporting period is approximately 14 percent (459 lbs) lower than that for the previous reporting period (2,826 lbs in 2009/2010 versus 3,285 lbs in 2008/2009. Given that the flow from the GWTS sites decreased less than two percent during this reporting period, the 14 percent decrease in mass removed is attributable to the decreasing contaminant concentrations at the restoration sites.

In addition to the mass removed by the groundwater extraction systems at each of the GWTS sites, the AS/SVE system at OT20, the SVE and gas collection systems at LF03, and the SVE system at OT17 also remove a significant quantity of contaminant mass. At OT20, a total of 59 lbs of TCE and 491 lbs of total VOCs were removed during this reporting period by the AS/SVE system. Historically, the AS/SVE system at OT20 has removed 827 lbs of TCE and 41,473 lbs of total VOCs. At LF03, a total of 19,256 lbs of organics was removed during this reporting period from the SVE and landfill gas collection systems. Of this mass, more than 92 percent was methane (17,712 lbs), with VOCs making up the remainder (1,544 lbs). Historically, the LF03 SVE and landfill gas collection systems have removed more than 127,498 lbs of organics, of which more than 96 percent was methane (122,270 lbs) and the remainder was VOCs (5,278 lbs). At OT17, it is estimated that the SVE system removed 117 lbs of TCE during the current reporting period. Historically, it is estimated that approximately 3,814 lbs of TCE has been removed by the OT17 SVE system.

10.3 COMPARISON OF GWTS VERSUS GWTP MASS REMOVAL TOTALS

In preparation of this report, mass removal estimates were calculated independently for both the GWTS sites and the GWTP. The mass removal estimates for each of the GWTS sites were calculated based on the flow and concentration data collected at each site. The mass removal estimates from each site were then summed to calculate the mass removal for the GWTS sites combined. It is noteworthy that, for this reporting period, the concentration data at the GWTS sites were typically based on samples collected: (i) once during the reporting period at the OT20, OT37, and OT41 groundwater extraction wells; (ii) two times during the reporting period at the OT17 groundwater extraction wells; and (iii) one to four times during the reporting period at the LF03 groundwater extraction, leachate collection, and dual-phase wells and the interceptor trench and the leachate transfer station.

Mass removal estimates for the GWTP were calculated based on the flow and concentration data collected at the plant. The combined influent to the GWTP was sampled twice a month during the entire reporting period, and these data were used to calculate the monthly mass removal totals. The monthly mass removal totals were later combined to establish the annual totals for the plant. The major difference in calculating the mass removal estimates for the GWTS sites and the GWTP is the frequency of the samples collected.

A comparison of the estimated total organics removed from the GWTS sites (as summarized in Table 10-4) to the GWTP (as summarized in Table 9-5) reveals that there are typically minor discrepancies (i.e., generally on the order of ±ten percent) in estimated total organics from year to year, until the reporting period of December 2004 to November 2005. Since then, the discrepancy between the mass removed by the GWTS and the mass removed by the GWTP has become more pronounced. During this reporting period, this discrepancy was 37 percent of the GWTS total or 1,041 lbs (total mass removal estimates for the GWTS and GWTP are 2,826 and 1,784 lbs, respectively).

One of the contributing factors to this discrepancy is the carbon pretreatment units at LF03. A carbon unit, installed in December 2002, treats leachate collected from the LF03 leachate collection wells prior to its entrance into the force main. A second unit, which became operational in July 2009, treats extracted groundwater collected from LF3EW7A and LF3EW10 prior to its entrance into the force main. These systems (each consisting of two carbon vessels in a lead and lag configuration, associated valves, and plumbing) were installed to prevent oil and grease compounds from interfering with the UV-Ox system operating at the GWTP. Because the units remove a substantial amount of the organic mass collected from these wells, the mass contribution from the wells with pretreated leachate or groundwater to the GWTP is relatively small. As discussed in 5.2.1, during this reporting period, the carbon in the pretreatment unit associated with the leachate collection wells was changed four times; and therefore, it is likely that minimal breakthrough of contaminants occurred.

Furthermore, as part of the routine O&M efforts, the LF03 transfer station sump was cleaned out several times during this reporting period [i.e., in January and July (twice) 2010]. These cleanout efforts resulted in removal of 765 gallons of concentrated leachate, which corresponds to approximately 596 lbs of contaminant mass removal, for off-site disposal. This mass was not captured by the pretreatment carbon units at LF03 or by the GWTP.

The removal of contaminant mass by the LF03 pretreatment units and the sump cleanout efforts resulted in less contaminant mass reporting to the GWTP. While this observation explains the discrepancy between the mass removed from the GWTP versus the mass removed from the GWTS, this discrepancy has no impact on the system performance; it simply highlights, to some degree, where the contaminants are treated. Ultimately, the leachate collected at LF03 is first pretreated and then further treated at the GWTP prior to discharge, in compliance with NPDES discharge limits, while small amounts are occasionally pumped from the wet well and separately handled as hazardous waste through Building 359.

10.4 CONCLUSIONS AND RECOMMENDATIONS

Figure 10-1 presents an overview of the December 2009 through November 2010 key operational data in a graphical format for the entire GWTS. The data presented include: (i) the flow contribution from each GWTS site as a percentage of the total GWTP flow; (ii) the mass removal contribution from each GWTS site as a percentage of the total organics removed from all of the GWTS sites combined; (iii) speciation of mass removed at the GWTS sites as percentages of the total organics mass removed (i.e., primary contaminants removed from groundwater); and (iv) contaminant mass removed in pounds. Figure 10-2 presents an historical summary of the flow data and mass removal estimates for the GWTP, as well as the mass removal estimates for the GWTS sites.

A review of Figures 10-1 and 10-2 and Tables 10-1 through 10-4 yields the following general observations and conclusions.

- While LF03 contributes approximately seven percent of the total flow to the GWTP, the mass removal from this site corresponds to an estimated 77 percent of the total mass removed by the GWTS. These data indicate that the remedial system in place at this site is the most efficient among the GWTS sites in removing contaminant mass, and that contaminant concentrations are higher at this site than at the other GWTS sites.

- Rapidly declining contaminant concentrations in groundwater and mass removal efficiencies at the remaining sites highlight the significant remedial progress that has been made as a result of the Base's proactive optimization efforts. The remedial progress achieved at LF04 led to the shutdown of the groundwater recovery system on 1 February 2007, and transitioning of site remedy to MNA was approved by the US EPA and the GA EPD in March and July 2010, respectively. Similar trends are emerging for other sites, particularly at OT20, OT37, and OT41, indicating that pumping from individual extraction wells and overall extraction systems at these sites is progressively yielding ever diminishing returns. It is anticipated that pumping from many of these locations will be discontinued in the near future, as mass removal efficiencies reach asymptotic levels.

As discussed in Section 5.0 (SWMU 3/LF03), at LF03, it is recommended that LF3EW3 be shut down. Contaminant concentrations at this extraction well have been below the MCL since November 2009. Given the potential for continued pumping from LF3EW3 to cause the groundwater contaminant plume to migrate toward this location, continued operation of this well is of little further benefit.

Additionally, as discussed in Section 8.0 (SWMU57/OT41 and SWMU 61), at SWMU 61, it is recommended that the remedial approach be transitioned to MNA. The data collected from the rebound assessment indicate no rebound in contaminant concentrations following the shutdown of the AS/SVE system. This recommendation was also made in the 2009 CAP Progress Report for SWMUs 59, 60 and 61 (Geosyntec, 2010). Based on the observation that COC concentrations have been below MCLs/RLs for a minimum of three consecutive sampling events at S61W1, S61W2, and S61W3, and consistent with the CAP requirements, it is also recommended that groundwater monitoring from these wells be discontinued. The contaminant concentrations in groundwater samples collected from S61W4, as well as monitoring wells located downgradient of the source area (i.e., where the OT41 and SWMU 61 plumes comingle), will continue to be monitored as part of the OT41 remedial strategy and reported as part of the Annual Progress Reports for the GWTS.

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TABLES

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Table 10-1A
Summary of Monthly Flow Totals for Groundwater Treatment System (GWTS)

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

	Monthly Flow Totals (gal)							
	GWTS Remediation Sites							GWTP Influent Flow[1]
	LF04[3]	OT20	LF03	OT17	OT37	OT41	GWTS All Sites Combined	
DEC 2009	--	14,932,305	2,245,051	8,249,382	1,143,556	2,164,664	28,734,958	29,286,897
JAN 2010	--	14,549,845	2,207,855	5,349,166	1,137,907	2,196,868	25,441,641	26,090,877
FEB 2010	--	12,847,765	1,723,864	7,986,111	1,019,403	1,986,657	25,563,800	26,125,366
MAR 2010	--	14,279,350	1,897,965	8,370,452	1,058,719	2,217,357	27,823,843	28,222,930
APR 2010	--	13,455,641	1,874,608	7,534,071	1,069,854	2,041,659	25,975,832	26,508,690
MAY 2010	--	14,124,441	1,874,087	8,808,764	1,090,754	2,041,464	27,939,511	28,413,116
JUN 2010	--	12,874,652	1,813,427	7,946,239	952,980	1,651,672	25,238,971	25,704,094
JUL 2010	--	14,280,572	1,926,520	8,649,480	1,027,587	1,929,012	27,813,172	28,204,550
AUG 2010	--	13,919,436	1,850,711	8,928,372	977,898	1,908,596	27,585,013	28,052,802
SEP 2010	--	12,666,329	1,951,792	8,131,442	1,013,945	1,920,978	25,684,486	25,967,192
OCT 2010	--	14,248,495	2,086,018	8,401,683	1,161,875	2,138,602	28,036,672	28,317,015
NOV 2010	--	13,359,046	1,872,160	8,469,068	1,121,737	2,089,742	26,911,754	27,446,501
DEC 09 - NOV 10 TOTAL (Gallons)	--	165,537,876	23,324,059	96,824,230	12,776,215	24,287,272	322,749,652	328,340,029
PERCENT OF TOTAL FLOW FROM GWTS SITES	--	51.3%	7.2%	30.0%	4.0%	7.5%	100.0%	--
PERCENT OF TOTAL INFLUENT FLOW TO THE GWTP	--	50.4%	7.1%	29.5%	3.9%	7.4%	98.3%	--
DEC 09 - NOV 10 AVERAGE FLOW RATE (GPD)[2]	--	453,528	63,902	272,744	35,003	66,540	884,246	899,562
DEC 09 - NOV 10 AVERAGE FLOW RATE (GPM)[2]	--	315.0	44.4	189.4	24.3	46.2	614.1	624.7

Notes:

-- Indicates the remediation system was shut down, and thus, no flow measurements were recorded.

(1) The difference between the GWTS and GWTP flow totals is probably attributable to the unmetered flow to the GWTP from the LF04 decon pad, AS/SVE condensate tanks, and the tanker unloading pad located at the GWTP and to variations in metering calibration.

(2) Yearly average flow rates in gpd and gpm are calculated based on the operational period of the well. However, the calculation does not account for periods of temporary downtime.

(3) Groundwater recovery from LF04 was discontinued, with regulatory approval, on 1 February 2007.

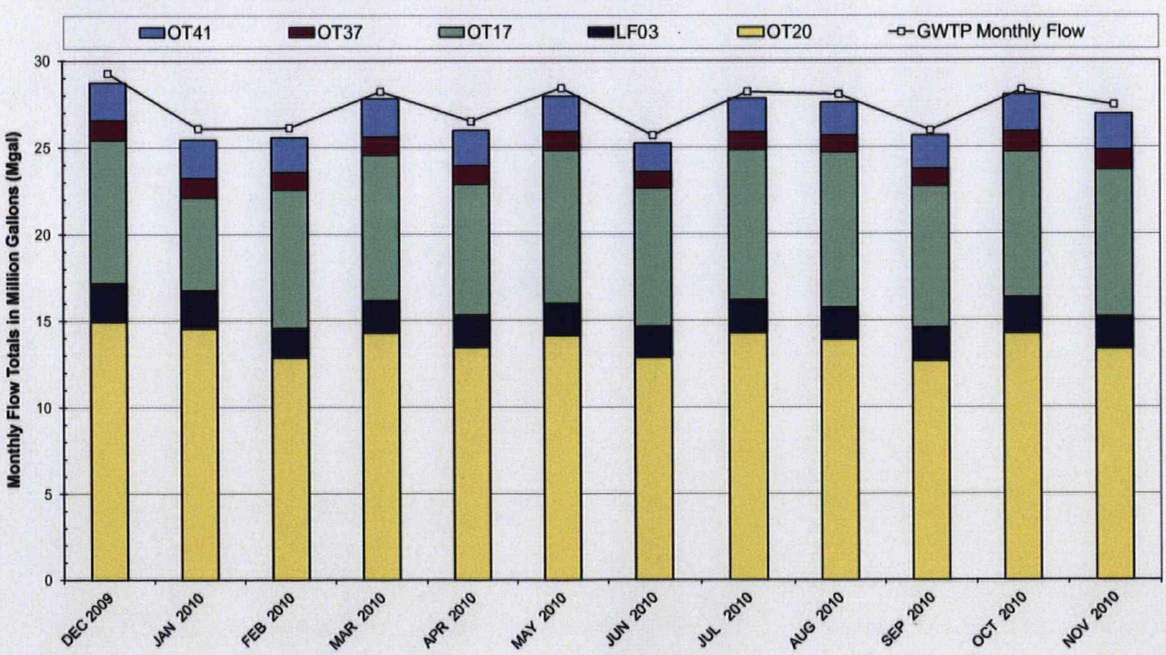


Table 10-1B
Summary of Historic Annual Flow Totals for Groundwater Treatment System (GWTS)

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

	Annual Flow Totals (gal)							
	GWTS Remediation Sites							GWTP Corrected[(1),(2),(3)] Influent Flow
	LF04[(4)]	OT20	LF03	OT17	OT37	OT41	GWTS All Sites Combined	
Dec 09 - Nov 10	--	165,537,876	23,324,059	96,824,230	12,776,215	24,287,272	322,749,652	328,340,029
Dec 08 - Nov 09	--	171,391,399	20,069,866	97,371,887	13,037,467	26,645,776	328,516,395	337,300,516
Dec 07 - Nov 08	--	171,983,402	17,715,188	93,713,590	13,469,346	27,288,872	324,170,398	333,242,269
Dec 06 - Nov 07	7,306,335	161,445,790	20,111,911	83,902,945	12,622,629	27,369,565	312,759,174	324,254,718
Dec 05 - Nov 06	49,680,720	154,418,976	15,621,295	81,036,466	9,107,205	21,730,737	331,595,399	342,406,771
Dec 04 - Nov 05	48,608,086	128,974,338	20,987,725	73,856,956	6,852,504	18,761,160	298,040,769	307,738,496
Dec 03 - Nov 04	46,104,333	117,665,401	18,545,909	69,532,732	1,884,385	20,356,939	274,089,699	282,700,942
Dec 02 - Nov 03	52,241,457	94,885,858	20,213,968	68,863,716	1,590,792	15,887,443	253,683,234	254,902,304
Dec 01 - Nov 02	50,402,798	55,471,426	18,432,122	62,848,888	356,573	6,591,581	194,103,388	197,144,301
Dec 00 - Nov 01	60,627,236	46,230,797	14,199,168	69,014,738	--	--	190,071,939	189,402,767
Dec 99 - Nov 00	61,265,292	32,018,829	10,842,795	36,857,098	--	--	140,984,014	151,499,178
Dec 98 - Nov 99	72,844,348	21,325,229	--	--	--	--	94,169,577	105,067,790
Oct 97 - Nov 98	76,681,957	24,905,381	--	--	--	--	101,587,338	120,202,487
TOTAL (Gallons)	525,762,562	1,346,254,701	200,064,006	833,823,246	71,697,115	188,919,346	3,166,520,976	3,274,202,568
PERCENT OF TOTAL FLOW FROM GWTS SITES	16.6%	42.5%	6.3%	26.3%	2.3%	6.0%	100.0%	
PERCENT OF TOTAL INFLUENT FLOW TO THE GWTP	16.1%	41.1%	6.1%	25.5%	2.2%	5.8%	96.7%	

Notes:

-- Indicates the remediation system was not in place or was shut down, and thus, no flow measurements were recorded.

(1) Until 8 December 2005, backwash water was typically returned to the front end of the plant after the influent sampling port, but prior to the flow meters and the inclined plate clarifier, and as a result, counted by the influent flow meters twice. Therefore, where applicable, influent flow volume and flow rates have been corrected by subtracting the backwash flow volume from the GWTP influent flow volume.

(2) From 8 December 2005 forward, the backwash water has been conveyed to the Base's Sanitary Treatment Plant; and therefore, correction of the influent flow totals is no longer necessary.

(3) The difference between the GWTS and GWTP flow totals is probably attributable to the unmetered flow to the GWTP from the LF04 decon pad, AS/SVE condensate tanks, and the tanker unloading pad located at the GWTP and to variations in metering calibration.

(4) Groundwater recovery from LF04 was discontinued, with regulatory approval, on 1 February 2007.

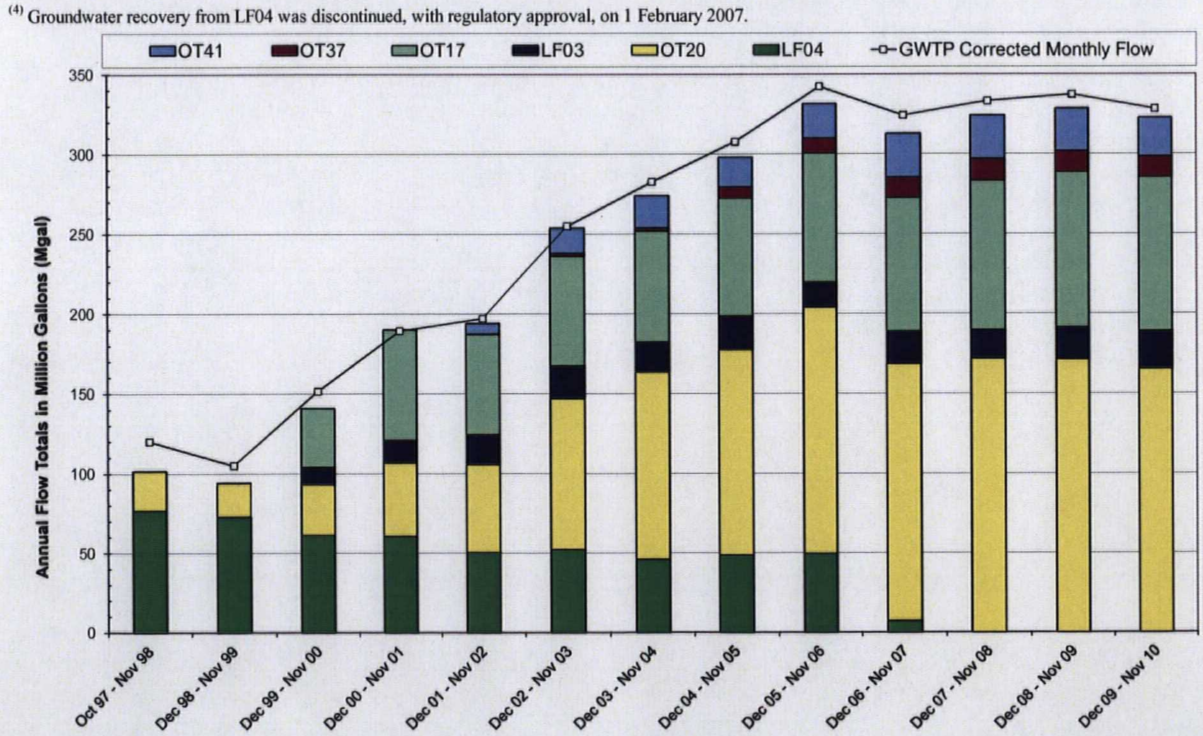


Table No. 10-2

Summary of GWTS Mass Removal Estimates for Dec 2009 - Nov 2010 [1]

GWTS Annual Progress Report (December 2009 - November 2010)

Robins Air Force Base, Georgia

	Annual GW Flow [1]			Total Organics: Total Mass Removed [1],[2]		Total Organics: Removal Efficiency	1,2-dichlorobenzene: Total Mass Removed		1,4-dichlorobenzene: Total Mass Removed	
	(gal)	(gpm) [4]	(%)	(lbs)	(%)	(lbs/Mgal)	(lbs)	(%)	(lbs)	(%)
LF04[3]	--	--	--	--	--	--	--	--	--	--
OT20	165,537,876	315.0	51.3	207.7	7.3	1.3	20.5	4.4	4.8	4.3
LF03[5]	23,324,059	44.4	7.2	2,179.4	77.1	93.4	442.2	95.4	104.7	94.5
OT17	96,824,230	184.2	30.0	365.7	12.9	3.8	0.0	0.0	0.0	0.0
OT37	12,776,215	24.3	4.0	7.9	0.3	0.6	0.0	0.0	0.0	0.0
OT41	24,287,272	46.2	7.5	65.0	2.3	2.7	0.7	0.1	1.3	1.2
Total	**322,749,652**	**614.1**	**100.0**	**2,825.6**	**100.0**	**8.8**	**463.3**	**100.0**	**110.8**	**100.0**

	Benzene: Total Mass Removed		Chlorobenzene: Total Mass Removed		Cis-1,2-dichloroethene: Total Mass Removed		PCE: Total Mass Removed		TCE: Total Mass Removed		Vinyl Chloride: Total Mass Removed	
	(lbs)	(%)	(lbs)	(%)	(lbs)	(%)	(lbs)	(%)	(lbs)	(%)	(lbs)	(%)
LF04[3]	--	--	--	--	--	--	--	--	--	--	--	--
OT20	0.9	2.6	18.6	3.9	46.9	18.6	12.8	72.7	99.3	6.8	.4.0	71.0
LF03[5]	23.4	69.9	407.1	85.4	191.9	76.2	2.8	15.9	1,005.7	68.6	1.6	29.0
OT17	0.0	0.0	0.0	0.0	12.3	4.9	0.0	0.0	353.4	24.1	0.0	0.0
OT37	0.0	0.0	0.0	0.0	0.3	0.1	2.0	11.4	5.5	0.4	0.0	0.0
OT41	9.2	27.5	50.8	10.7	0.6	0.2	0.0	0.0	2.5	0.2	0.0	0.0
Total	**33.4**	**100.0**	**476.5**	**100.0**	**251.9**	**100.0**	**17.7**	**100.0**	**1,466.4**	**100.0**	**5.6**	**100.0**

	1,2-dichlorobenzene	1,4-dichlorobenzene	Benzene	Chlorobenzene	Cis-1,2-dichloroethene	PCE	TCE	Vinyl Chloride
Percent Contribution to the Total Mass Removed	16.4%	3.9%	1.2%	16.9%	8.9%	0.6%	51.9%	0.2%

Notes:

-- Pump not operational in the given period of time.

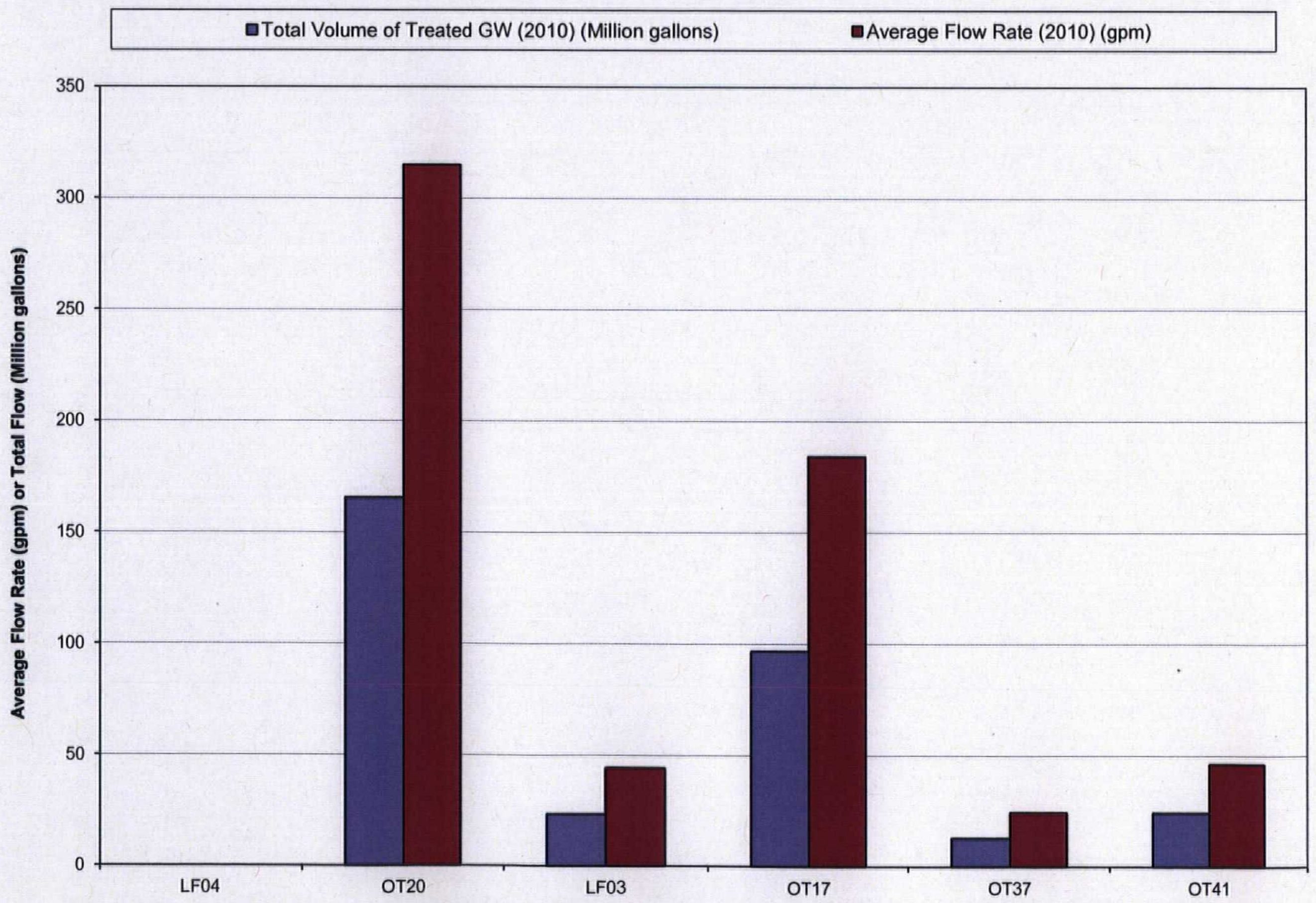
(1) The annual flow total and mass removal estimates for all GWTS sites combined may be different than the GWTP annual flow total and mass removal estimates (see discussions in Subsections 10.1 and 10.3 of this report).

(2) The sum of the masses of the individual reporting periods may not be equal to the overall mass due to rounding.

(3) Groundwater recovery from LF04 was discontinued, with regulatory approval, on 1 February 2007.

(4) Yearly average flow rates in gpd and gpm are calculated based on the operational period of the well. However, the calculation does not account for periods of temporary downtime.

(5) Periodic LF03 transfer station sump cleanout efforts during this reporting period resulted in removal of approximately 765 gallons of concentrated leachate for off-site disposal, which is estimated to correspond to 596 lbs of additional contaminant mass removal from LF03.



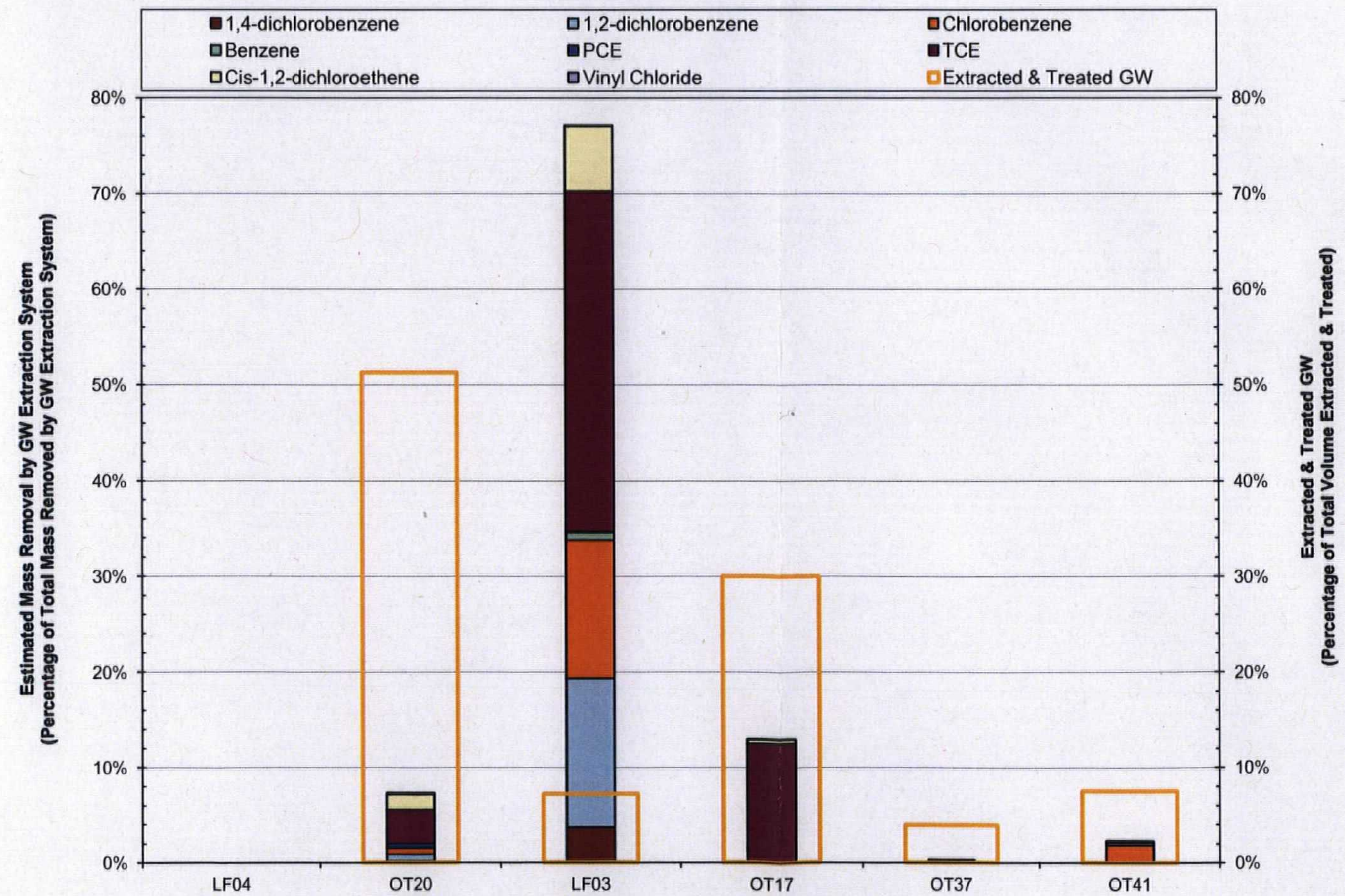


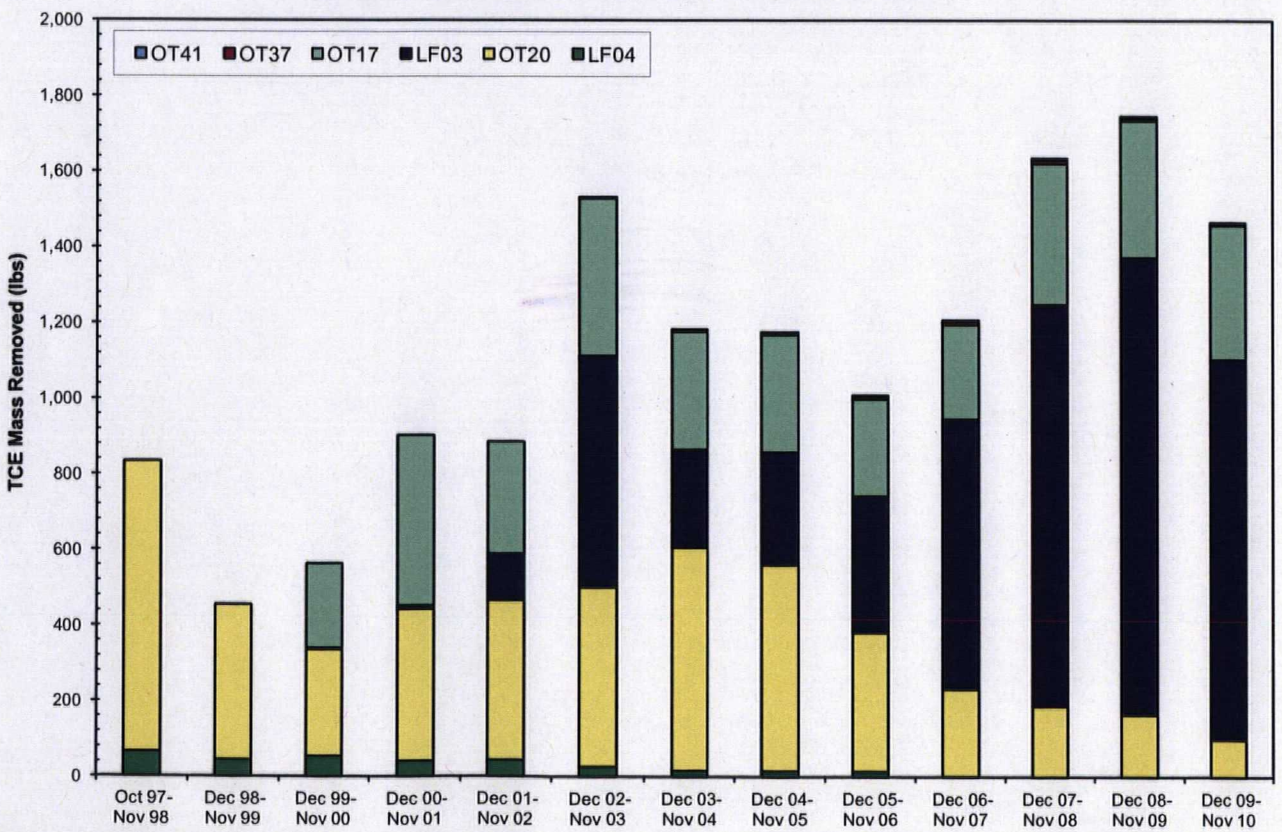
Table No. 10-3
Historical Mass Removal Estimates for GWTS Restoration Sites

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

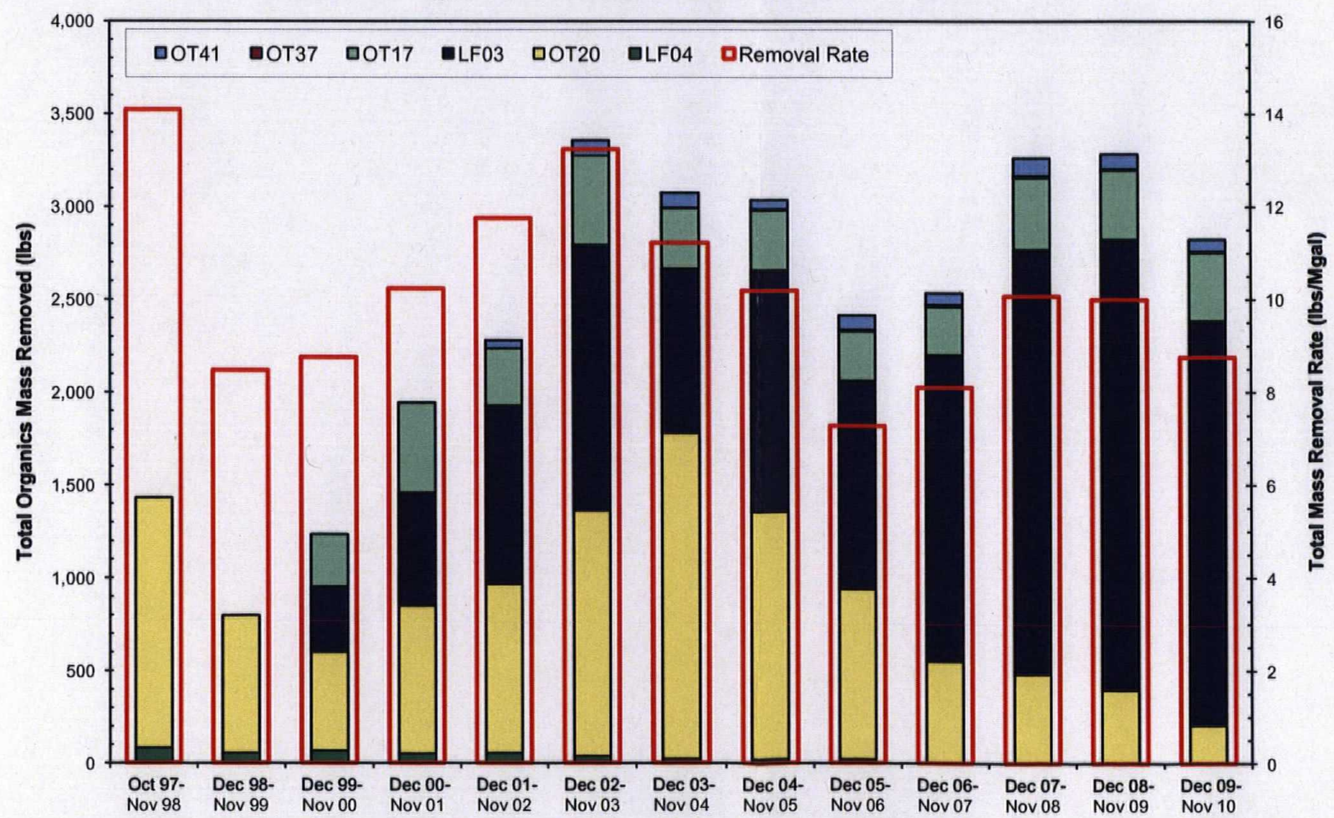
Reporting Period	Total Annual Flow [1] (gal)	LF04 [4] Estimated Mass Removed TCE (lbs)	LF04 [4] Estimated Mass Removed Total VOCs (lbs)	OT20 Estimated Mass Removed TCE (lbs)	OT20 Estimated Mass Removed Total VOCs (lbs)	LF03 [3], [5] Estimated Mass Removed TCE (lbs)	LF03 [3], [5] Estimated Mass Removed Total VOCs (lbs)	OT17 Estimated Mass Removed TCE (lbs)	OT17 Estimated Mass Removed Total VOCs (lbs)	OT37 Estimated Mass Removed TCE (lbs)	OT37 Estimated Mass Removed Total VOCs (lbs)	OT41 Estimated Mass Removed TCE (lbs)	OT41 Estimated Mass Removed Total VOCs (lbs)	GW Extraction System Total [1] [2] Estimated Mass Removed TCE (lbs)	GW Extraction System Total [1] [2] Estimated Mass Removed Total VOCs (lbs)	Mass Removal Rate (lbs/Mgal)
Dec 2009 - Nov 2010	322,749,652	--	--	99.3	208	1,006	2,179	353	366	5.5	7.9	2.5	65.0	1,466	2,826	8.8
Dec 2008 - Nov 2009	328,516,395	--	--	165	396	1,209	2,429	361	371	6.7	9.5	4.9	78.9	1,747	3,285	10.0
Dec 2007 - Nov 2008	324,170,398	--	--	187	483	1,062	2,286	373	387	8.9	11.7	5.5	95.7	1,637	3,265	10.1
Dec 2006 - Nov 2007	312,759,174	1.8	2.6	231	548	715	1,656	248	256	9.1	11.7	2.5	62.9	1,208	2,537	8.1
Dec 2005 - Nov 2006	331,595,399	15.1	22.7	367	918	362	1,125	256	264	8.2	10.6	2.5	75.4	1,010	2,416	7.3
Dec 2004 - Nov 2005	298,040,769	15.5	23.4	546	1,333	299	1,302	309	322	6.7	8.5	1.7	49.1	1,177	3,038	10.2
Dec 2003 - Nov 2004	274,089,699	16.3	24.2	590	1,756	260	888	311	326	1.7	2.2	4.9	80.3	1,184	3,076	11.2
Dec 2002 - Nov 2003	253,683,234	26.8	37.0	474	1,327	612	1,432	416	481	0.7	0.9	2.9	81.4	1,533	3,359	13.2
Dec 2001 - Nov 2002	194,103,388	44.0	54.2	423	912	124	965	295	306	0.0	0.1	0.6	45.0	887	2,282	11.8
Dec 2000 - Nov 2001	190,071,939	40.7	52.0	402	798	10.9	610	449	485	--	--	--	--	903	1,945	10.2
Dec 1999 - Nov 2000	140,984,014	53.4	67.4	284	531	4.1	354	223	281	--	--	--	--	564	1,234	8.8
Dec 1998 - Nov 1999	94,169,577	44.6	56.1	411	742	--	--	--	--	--	--	--	--	455	798	8.5
Oct 1997 - Nov 1998	101,587,338	65.5	82.3	768	1,349	--	--	--	--	--	--	--	--	834	1,432	14.1
Total	**3,166,520,976**	**324**	**422**	**4,947**	**11,301**	**5,664**	**15,227**	**3,594**	**3,845**	**47.5**	**62.9**	**27.9**	**634**	**14,604**	**31,493**	**9.9**

Notes:
-- Pump not operational in the given period of time.
[1] The annual flow total and mass removal estimates for all GWTS sites combined may be different than the GWTP annual flow total and mass removal estimates.
[2] The sum of the masses of the individual reporting periods may not be equal to the overall mass due to rounding.
[3] Phase II and Phase III expansions of the GWTS occurred in May 2000 and August 2002, respectively. Deepening of the LF03 leachate collection wells occurred in March 2003. Leachate collection from the LF03 dual-phase wells began in June 2008.
[4] Groundwater recovery from LF04 was discontinued, with regulatory approval, on 1 February 2007.
[5] Periodic LF03 transfer station sump cleanout efforts during this reporting period resulted in removal of approximately 765 gallons of concentrated leachate for off-site disposal, which is estimated to correspond to 596 lbs of additional contaminant mass removal from LF03.

Historical TCE Mass Removal Estimates for GWTS Restoration Sites



Historical Total Organics Mass Removal Estimates for GWTS Restoration Sites



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2010.Table 10-3-HistMassEstforGWTS.xlsx

Table No. 10-4

Historical Cumulative Mass Removal Estimates for GWTS Restoration Sites [1]

GWTS Annual Progress Report (December 2009 - November 2010)
Robins Air Force Base, Georgia

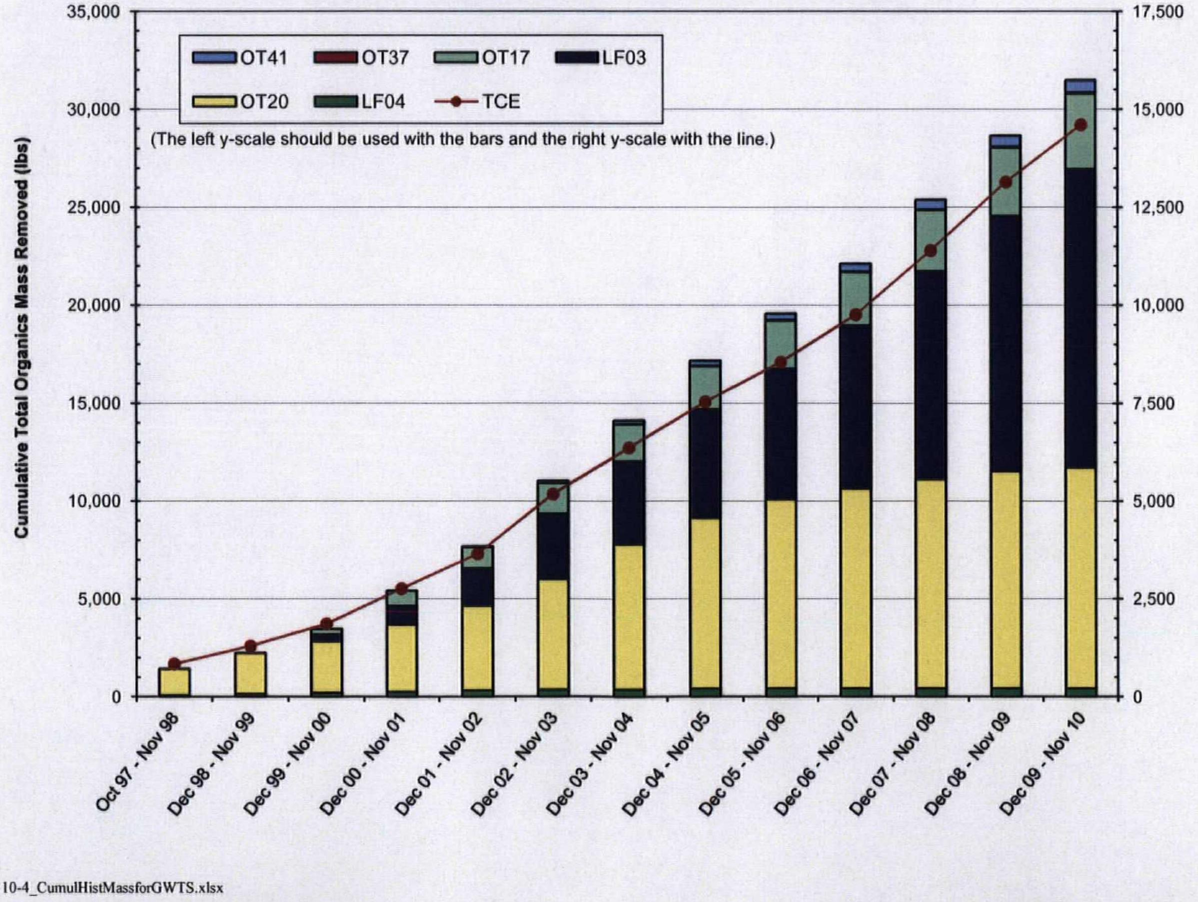
Reporting Period	Total Annual Flow [1] (gal)	GW Extraction System Total [1] Estimated Mass Removed TCE (lbs)	Total VOCs (lbs)	Mass Removal Rate (lbs/Mgal)
Dec 2009 - Nov 2010 [2]	322,749,652	1,466	2,826	8.8
Dec 2008 - Nov 2009 [2]	328,516,395	1,747	3,285	10.0
Dec 2007 - Nov 2008 [2]	324,170,398	1,637	3,265	10.1
Dec 2006 - Nov 2007	312,759,174	1,208	2,537	8.1
Dec 2005 - Nov 2006	331,595,399	1,010	2,416	7.3
Dec 2004 - Nov 2005	298,040,769	1,177	3,038	10.2
Dec 2003 - Nov 2004	274,089,699	1,184	3,076	11.2
Dec 2002 - Nov 2003	253,683,234	1,533	3,359	13.2
Dec 2001 - Nov 2002	194,103,388	887	2,282	11.8
Dec 2000 - Nov 2001	190,071,939	903	1,945	10.2
Dec 1999 - Nov 2000	140,984,014	564	1,234	8.8
Dec 1998 - Nov 1999	94,169,577	455	798	8.5
Oct 1997 - Nov 1998	101,587,338	834	1,432	14.1
Total	**3,166,520,976**	**14,604**	**31,493**	**9.9**

Notes:

[1] The annual flow total and mass removal estimates for all GWTS sites combined may be different than the GWTP annual flow total and mass removal estimates (see discussions in Subsections 10.1 and 10.3 of this report).

[2] Periodic LF03 leachate transfer station sump cleanout efforts since 2007 have resulted in an estimated 629 lbs of additional contaminant mass removal from LF03.

Historical Cumulative Mass Removal Estimates for GWTS Restoration Sites



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FIGURES

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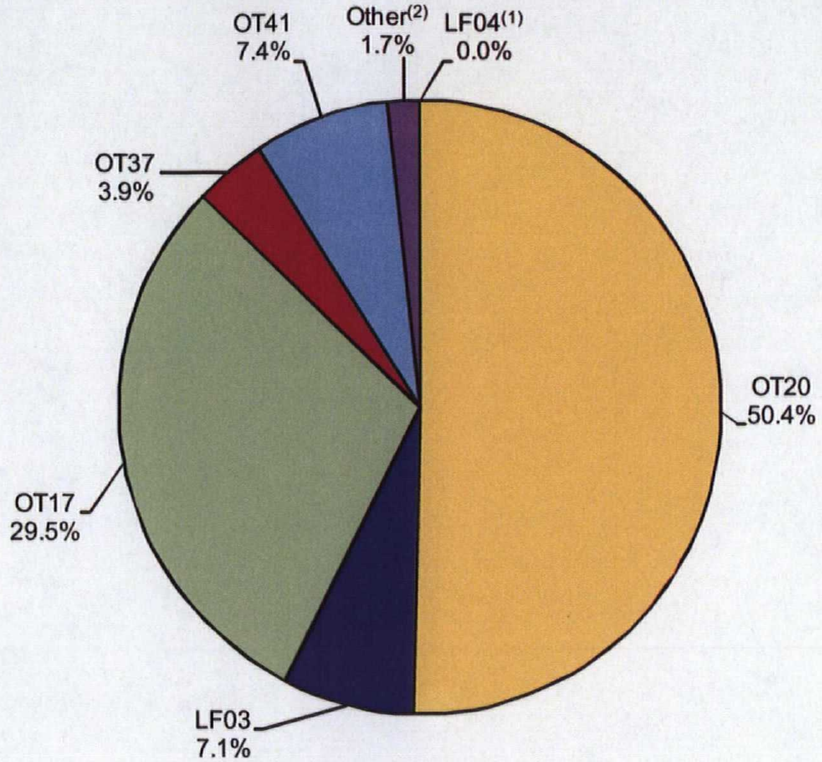
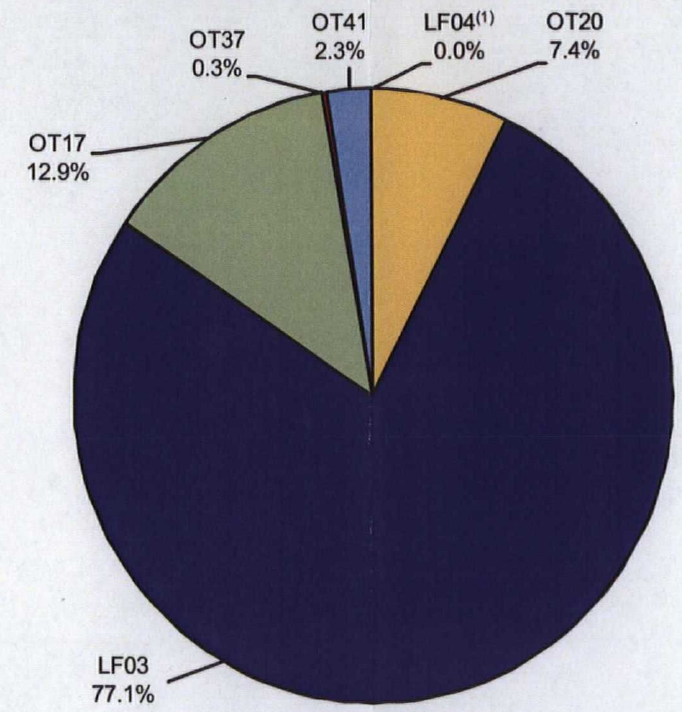
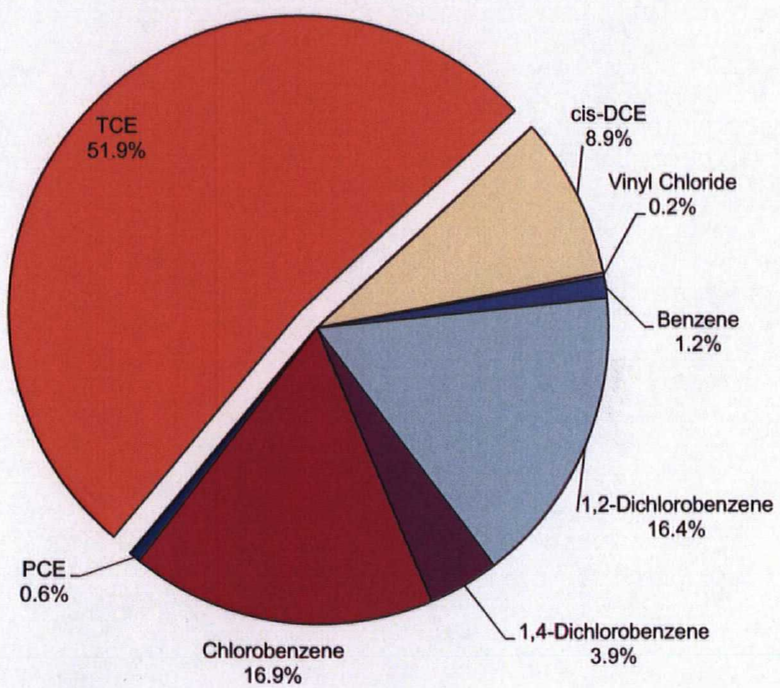
GWTS Flow Contributions
(Percent of Total GWTP Flow)



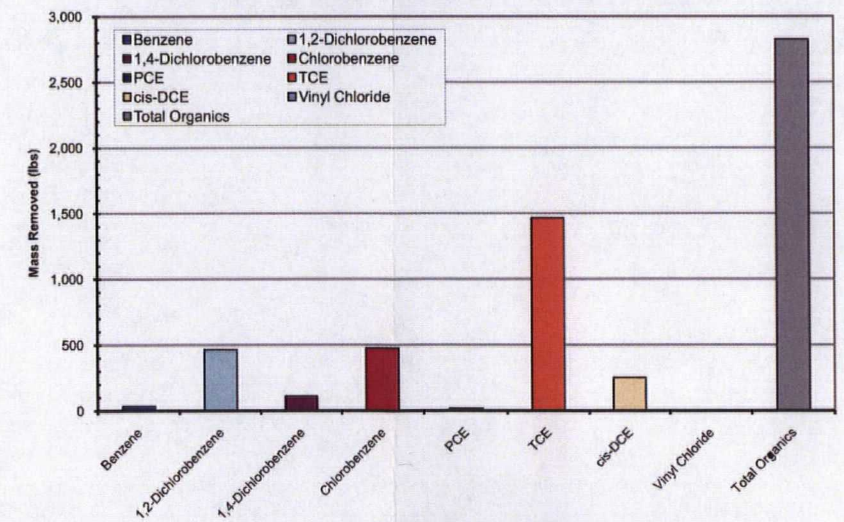
GWTS Estimated Mass Removal Contributions
(Percent of Estimated Total Organics Mass Removed at the GWTS Restoration Sites)



Speciation of Mass Removed at GWTS Restoration Sites(3)



Comparative Analysis of Mass Removal Estimates
(Data Origin: GWTS Restoration Sites)



Notes:
(1) Groundwater recovery from LF04 was discontinued, with regulatory approval, on 1 February 2007.
(2) "Other" represents the difference between the GWTS and GWTP flow totals, which is likely associated with the unmetered flow to the GWTP from the LF04 decon pad, AS/SVE condensate tanks, and the tanker unloading pad located at the GWTP and to variations in metering calibration.
(3) Estimated Total Organics Removed at GWTS Remediation Sites is 2,825 lbs.

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
DOCUMENT NO.	GA100539		
FILE NO.	0057F10-1.CDR		
PREPARED BY	SF	DATE	01/25/2011
CHECKED BY	TH	DATE	01/27/2011

PREPARED FOR
DELIVERY ORDER 0005
TASK NO. 5

PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009- NOV 2010

SITE DESCRIPTION
OVERALL GWTS
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
FLOW AND MASS REMOVAL CONTRIBUTIONS AND SPECIATION OF ORGANIC MASS REMOVED

FIGURE NO.
10-1

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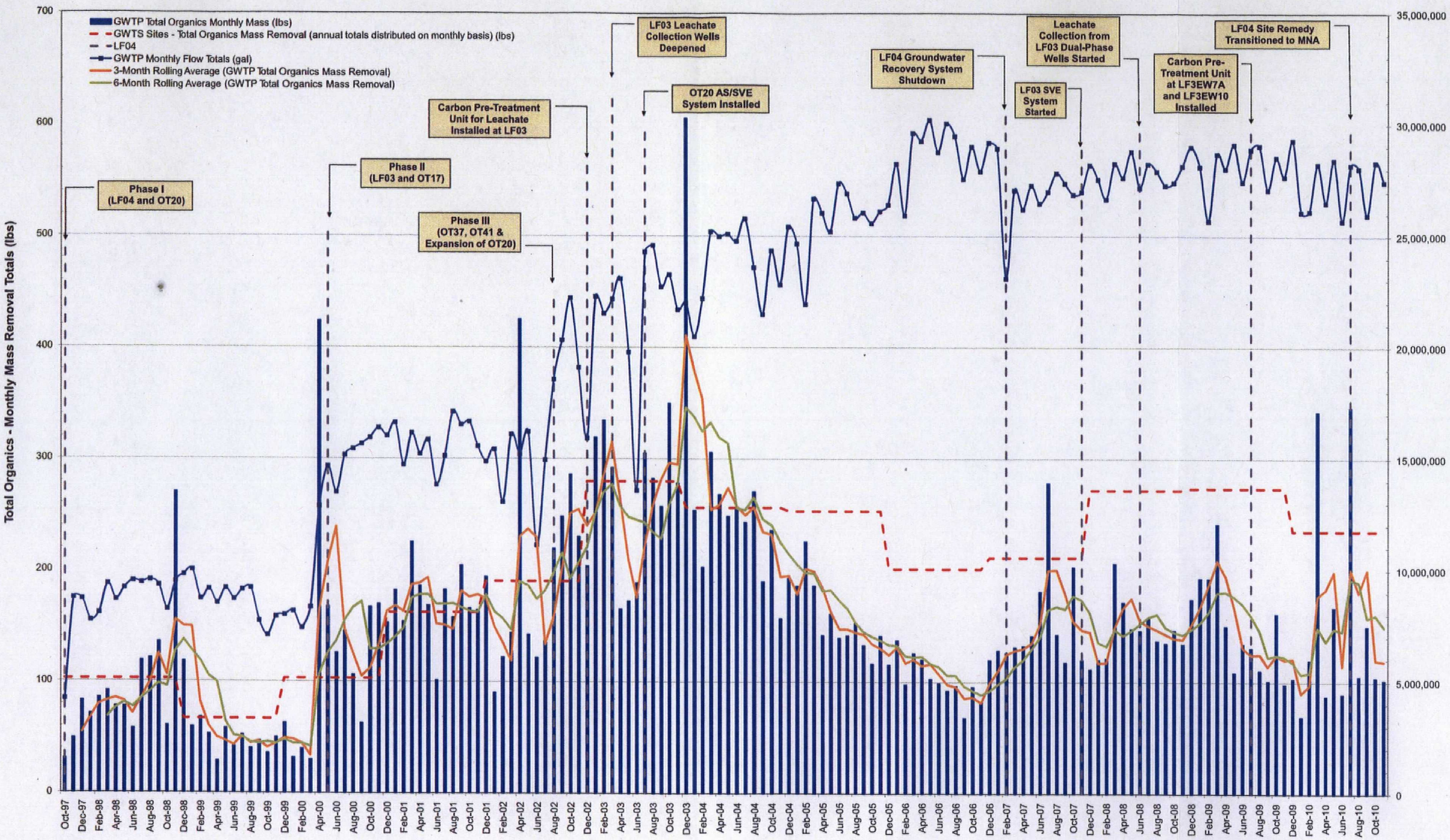

ENVIRONMENTAL MANAGEMENT
78th CIVIL ENGINEER GROUP
Robins AFB, Georgia

78th Civil Engineer

ABOVE THE FOE

PREPARED BY	Geosyntec consultants		
PROJECT NO.	GW0054/5		
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PREPARED BY	SF	DATE	01/27/2011
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PREPARED FOR

ENVIRONMENTAL MANAGEMENT
ROBINS AFB

DELIVERY ORDER 0005
TASK NO. 5

PROJECT NAME
GWTS ANNUAL PROGRESS REPORT
DEC 2009- NOV 2010

SITE DESCRIPTION
OVERALL GWTS
ROBINS AFB, GEORGIA

FIGURE DESCRIPTION
SUMMARY OF HISTORIC FLOW DATA AND MASS REMOVAL ESTIMATES

FIGURE NO.
10-2

R:\Corel Data\ac-draw\a-projects\a-robins\GW0054

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